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Engineering News-Record

A Consolidation of Engineering News and Engineering Record
McGRAW-HILL PUBLISHING COMPANY, Inc.
AUGUST 23, 1917

Drawspan of New Bridge Over Ozama River in San Domingo

Cover released by courtesy of Golden-Anderson Valve Specialty Co., Pittsburgh, Pa.

Kreolite Wood Block Floors
"They outlast the factory"

Kreolite Grooved Wood Block Floor in Assembling Room of the Kent-Owens Company, Toledo.

This Kreolite Wood Block Floor is Bonded Firmly Together

Interior wood block floors should be laid up tight and smooth, and as rectangular blocks fit so close together that it is almost impossible to get the pitch filler between the blocks in sufficient quantity to be of any real value, the Kreolite Grooved Block is put forth to overcome this objection.

The Grooved Block has three V-shaped grooves on one side, which are one-half inch wide, and a quarter inch deep. The grooves also break the continuity of the large annual rings, and thereby eliminate shrinking.

The success of any wood block floor depends upon the rigidity of the individual blocks. If the blocks are tight and firm they will wear indefinitely. If they become loose under wearand tear they will disintegrate rapidly.

The floor in the above view receives very hard wear from the iron castings and the trucking over the floor.

THE JENNISON-WRIGHT COMPANY

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

How An Engineer May Lose His Fee

THE business condition of the consulting engineer, already not the best, on account of low and uncertain fees, can be made worse by cutting off the fees altogether. Within the past week one engineer had just this experience, although there was the satisfaction that it was the decision of a regularly constituted judge which deprived him of his fee. The engineer had drawn plans for a piece of city work, being retained by the city for a specified percentage of the cost of construction. The work was not executed, so naturally there was no cost of construction. The result was that the city declined to pay and on suit the judge decided in the city's favor; more than this, he required the engineer to return a certain amount of money that he had received on account. The Board of Public Works had made the contract with the engineer, and the common council had apparently failed to approve the action, which the court held to be a fatal defect in the arrangement. But the decision also dwelt on the non-existence of a construction cost as a factor in the case. Thus, there seem to have been two reasons for loosing the fee.

Mean Sea Level As Universal Datum

IN THE MIDST of rushing war work it is interesting to receive a reminder of peace-time engineering efficiency from a Government department whose own present duties lie largely in aiding the military work. E. Lester Jones, superintendent of the Coast and Geodetic Survey, gives in a pamphlet just issued the results of an extended inquiry on the use of mean sea level as datum plane for elevations. Quite a number of cities, state bureaus, railways and other authorities refer all their elevations to this standard datum, and many others are working toward the same end. But arbitrary datum planes are still in the large majority. One way in which this is harmful is that confusion or error may result wherever surveys based on independent datums have to be connected. Mr. Jones' report thus points toward a chance for promoting the efficiency of engineering work—the adoption of mean sea level as universal datum plane in America. An extensive list of accurately determined altitudes is already available in a Government publication, but much more precise-leveling work needs to be done if a really adequate number of benchmarks is to be provided throughout the country. This will be work for after the war.

Factors in Tractive Resistance

THE REPORT of the tests made in California on the tractive resistance of various types of road surfaces—an account of which is given on p. 367 of this issue—should be read with the proper accent on the fact that the temperatures were unusually high, 105 F. being reached each day. The effect of this upon asphaltic mat surfaces should not be overlooked nor underweighed in any attempt to apply the conclusions to a locality where such extremes are not only unusual but unheard of. As a test-series, the results are too meagre to allow anything beyond the roughest classification of paved roads. But as a measure of the value of hard surfaces over dirt, macadam or graveled roads, the evidence is indisputable.

Special Problems on the Army Camp Contracts

ALTHOUGH all of the sixteen cantonments for the National Army had their origin in certain standard plans issued from Washington just before construction contracts were awarded, local conditions at the various sites have, in most cases, made each job different from the next. Open country, such as is found at Camp Dix, near Wrightstown, N. J., allowed the contractor to begin building operations without many preliminaries. At Yaphank, Long Island, where Camp Upton is being constructed, as described in the article on page 340, the case was entirely different. The ground at Yaphank is covered by a dense growth of scrub oak, pine, and underbrush, a condition which demanded a huge amount of clearing and grubbing before the more spectacular work of rushing the wooden barracks could be started. With the ground cleared, however, the contractor is endeavoring to speed up the building construction by framing the sides of the structures on the finished flooring and lifting them, when completed, from a horizontal into a vertical plane, thus eliminating the use of scaffolding. This scheme of construction, it is understood, has not been followed generally, at the other camps, where side walls and ends have been built upright instead of flat.

It would be highly instructive, therefore, to get comparative figures on the speeds and labor costs attainable by the use of these two construction methods. Just at present, however, everybody on the sixteen big contracts is too busy for any such analysis.

Wanted—Students for Engineering Schools

ENGINEERING NEWS-RECORD has consistently urged holding all the technical students who have not actually or nearly completed their courses in the technical schools of the country, instead of encouraging their early entrance into the armies that are being raised. That stand was not popular among the men, who felt deprived of an equal chance with their fellows in sharing the honors of battle. But in the last analysis it called on them for a higher type of patriotism. We hold, moreover, that it is best temporarily to exempt from the draft those men who are actually following engineering, chemical and medical courses in American colleges—on the score of their higher usefulness after their studies have been completed.

More than a mere holding of the technical students in college is what we would now urge. We earnestly advocate a heavy enrollment in the entering classes of this and subsequent years.

But in urging that every proper influence be brought to bear upon qualified candidates to take up technical courses, we cannot unreservedly subscribe to propaganda which has recently been started. The arguments used to float this propaganda are: That after the war the whole world will have to be reconstructed by American engineers; that there is an appalling dearth of engineers abroad, and soon will be here; that European technical schools are completely paralyzed, and American schools bid fair to be; that the general demand for engineering service is beyond the supply in America; that engineering is sure to be the most lucrative profession in a few years.

In regard to all such claims we feel, from our own multiplied observation and contact with workers and work, that a vast amount of engineering effort will be needed in rebuilding within the theater of war, but the devastated areas are not such an appreciable percentage of the European built-up districts that all the engineers of the world will be engaged on rehabilitation for an indefinite time. War casualties among the engineers of other countries have been heavy, but the profession abroad is not reduced to uselessness through its reduction in numbers or in leaders. In America there are engineers for any class of work sufficient to meet all existing demands—except in certain industrial lines where the demand is apt to be more or less temporary. There is no conclusive evidence of such general improvement in the status and emoluments of engineers as warrants drawing men into this field.

Our conviction that entrance to the technical courses of our colleges should be stimulated to the maximum number that can be accommodated springs from our realization that the field for engineer efforts certainly will not be restricted and that a wide variety and great number of dire contingencies to our country can be provided against if the supply of technical graduates is normal or somewhat larger. Our conviction springs, also, from the feeling that the educational value of technical courses is as great as possibly can be secured from any higher education, and that they well train their graduates in mental processes and attitudes of great value in a business career.

In thus urging to greater efforts everyone who has any contact with or influence upon possible students, we would have greater emphasis than ever put on proper *qualifications*—an innate bent for things scientific, a creative imagination, and a peculiar sensibleness (so far as they can be recognized in a youth of 18), coupled with adequate preparation in general studies, mathematics and natural science.

Field Forces Doing Splendid Work on Cantonments

A SURVEY of the work under way at the cantonments for the national army affords the country cause for congratulation on the exceptional ability of the men selected to carry out the work and on the efficiency and accomplishments of the organizations built up at each of the sixteen locations. Single operations of such magnitude as to throw out of balance the national markets for such things as lumber and water pipe are so rare that the size of this undertaking is scarcely grasped even by the engineering public.

That work of this unusual character should be developed into full swing in the short space of time since it was authorized by Congress, and should be carried out, as this bids fair to be, within 2½ months, or at a rate approaching $800,000 a day, speaks well for the caliber of the material from which the construction forces have been drawn. The best of engineering and construction talent, however, could not have accomplished these results if the men selected to coördinate the various forces working at each site had not showed exceptional ability. Existing organizations of contracting, engineering and accounting firms have been brought together on work which was new to them in many of its aspects, and harmonized in a truly remarkable manner. The red tape which often in the past hampered operations undertaken by Government agencies has been cut without hesitation where it threatened the progress of the work. The first thought in the mind of each constructing quartermaster has been to get his cantonment finished in time for the country to use it. Small jealousies have been overridden and bickerings avoided by all concerned, in an effort to accomplish the task on time.

Of course sources of friction have developed here and there—no work of this size is ever achieved without them, but they have promptly been adjusted, and nowhere have been allowed to hamper the rapid progress of construction. The supply of materials has not always been perfect, due simply to the extraordinary quantity in which they had to be supplied; but the resourcefulness and energy exhibited in overcoming such difficulties has proved equal to every occasion.

It is further cause for congratulation that the resources of no section have failed to measure up to the emergency. Fears that the Northern firms would be unable to find labor; that the Southern work, hampered by summer heat, would not develop sufficient energy to push it to prompt completion; that the railroads and general contractors would not be able to organize the building work effectively; that the building contractors would find their city transportation methods unsuited to the open country; all have proved unfounded. Each force has found a way through the obstacles peculiar to its location.

The fact that, as soon as it is ready for them, the country will have adequate and almost ideal camps in which to train its great National Army is due to the skill and devotion of its engineering and construction forces, to wisdom of making the most of existing organizations, and to the fortunate selection of men of great personal ability to carry out the work.

Search the Scrap Piles

AMERICAN extravagance has not been confined to food and household supplies. In the rush for efficiency in output, much industrial machinery and equipment, or parts and supplies, has gone to the scrap pile for lack of adequate scrutiny with a view to its reclamation. The present unparalleled demand on our stores of metal, and the difficulties of freight transportation, are resulting in more repairing, less discarding, and wider utilization of shop odds and ends. There is coming, moreover, deeper and deeper search of scrap piles for accumulated pieces that may be salvaged. One notable instance of what may be done deserves more than passing notice—the accomplishment of oxyacetylene processes of cutting and welding, resulting from certain missionary activities of the sales promoters of commercial apparatus.

It is reported that at one Western mine, a three months' supply of dollies and dies was secured by welding up the old ones in the discard—at a cost of only $1 each, compared with $9 for new ones. There was also found in the scrap, recoverable stamp stems enough to last three months. Short ends of tungsten steel were welded together and the supply replaced purchases for a year. Some oversized manganese-steel crusher plates costing $20 each were cut down by the gas flame and put to use. In a certain railroad shop there was a wealth of old locomotive drivers with cracked spokes. The cracks were welded and the wheels made to turn again. A shortage was experienced in boiler tubes for renewals, but in the tube junk there were sufficient good short lengths to be welded into tubes for all the engines awaiting renewals. Such instances could be multiplied; we look to see their number grow until they excite no surprise. The possibility of many similar conservation services is strong—as from aluminothermic welding of heavy pieces. The reclamation of the scrap pile has only started!

Will the Barge Canal Become a Ship Canal After All?

TO THOSE who followed the long and occasionally violent controversy between the ship and barge canal adherents of fifteen to twenty years ago there is an element of humor in the possible use of lake and ocean ships on the New York State Barge Canal. Certainly every one thought that the 1903 referendum definitely restricted the canal to 1000-ton barges which would have to be loaded and unloaded at the terminals, but apparently those who were responsible for the subsequent widening of the locks to pass the Welland canal traffic unwittingly made feasible the building of boats which can traverse both lake and canal, and even the ocean.

That some interests are considering this possibility is pointed out in the article on the canal navigation on page 348. Whether their schemes will be practicable remains to be seen. A ship design has been perfected which satisfies the requirements of ocean and lake safety and at the same time—by a dangerously narrow margin—is under the canal clearances. There is no doubt that the navigation end of the problem is solved, if one assumes the practicability of a dispatching system through the narrow stretches of the canal, but the economic advantage is not so sure. Only experience can tell whether the saving in transfer of bulk at the canal terminals will outweigh the increased fixed charges and expenses of the ship, particularly as its lake or ocean capacity seem to be so much larger than its canal capacity that some cargo transfer is necessary if the full load is to be carried in the wider waters. As an element in its favor at present and for some time in the future, the canal ship has a margin of economic safety in its possible use as an ocean carrier during the five months' winter shut-down of lake and canal.

For such companies as the General Electric the combined lake, canal and ocean boat has a further economic advantage. If workable it frees much freight from the delays and restrictions of railroad travel, which in these days of embargoes and car shortage is an important item.

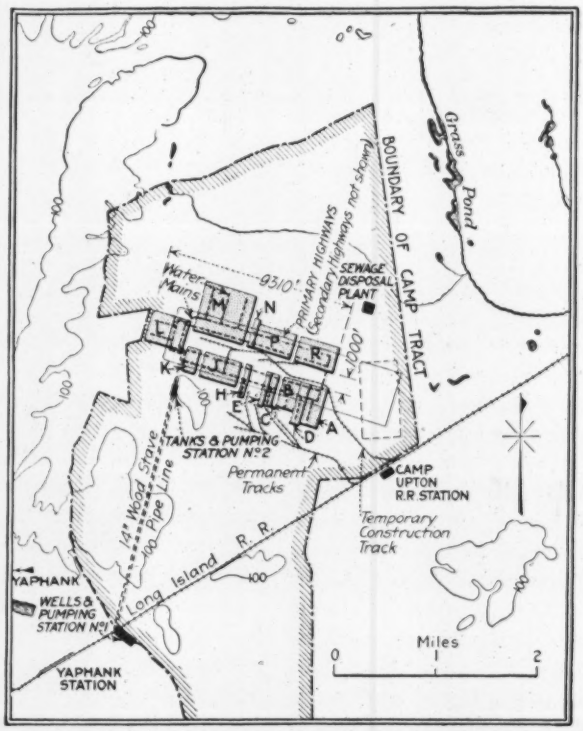
In certain restricted circles there has been much argument about the possibility of operating ships for the dual service. This has been a particularly fertile field for the naval architects, who in their public discussions at least, have been unable to agree. Argument is about exhausted. The prospect of the use of the canal for ships must depend on actual experience; theoretical analysis is only just so much theory. The fact remains—and it may profitably be brought to the attention of the barge-canal enthusiasts of Buffalo and New York—that today, when the canal is in service in two of its branches and when the full completion is only one season away, the only ordered planning for shipping through the canal is coming from those who propose using it as a ship channel. Which, we repeat, adds an element of humor when one remembers the violent arguments of the late nineties.

Engineering Team-Work Aids Rush Army Job at Camp Upton, N. Y.

Constructing Quartermaster and All of His Division Heads at Yaphank Cantonment Formerly Worked Together in Same Organization—Barracks Sides Built Flat and Raised to Place

By Robert K. Tomlin, Jr.
Managing Editor, "Engineering News-Record"

FOR Official Washington to put Yaphank, Long Island, "on the map" by naming it as the site for Camp Upton, one of the sixteen great cantonment cities for the National Army, was an extremely easy problem compared with that of putting this territory on the map, literally—a job upon which engineering and contracting forces, operating under the direction of the Quartermaster Department of the U. S. Army, have been engaged since the contract was signed June 25. These men are at work filling the stupendous order of producing a complete city for 40,000 inhabitants in only a few months' time, and they had practically nothing to start with except an 11,000-acre tract of land so densely covered with underbrush, scrub oak and pine, as to prevent the running of even the roughest sort of survey line until advance parties had chopped sighting lanes through the thick foliage. In fact, local conditions have really created two big jobs at Camp Upton—the first, getting ready to build; the second, actual building. When I visited the camp early this month the preliminary stage of the great construction project had been about completed; the first permanent wooden barracks structure was put under roof Aug. 3, although a number of smaller temporary structures had been completed previously.



OWING TO FLATNESS OF SITE IT WAS POSSIBLE TO GROUP BUILDINGS ACCORDING TO WAR DEPARTMENT'S STANDARD PLAN

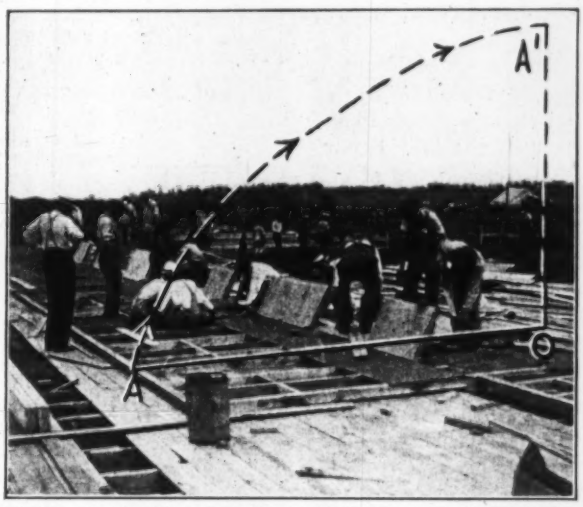
How Work Is Organized

The organization of the engineering staff was the first task which confronted Major O'K. Myers, an engineer selected from civil life as Constructing Quartermaster to have supreme charge of the camp work. Prior to his entry into the Government service, Major Myers had seen extensive duty on New York City's Catskill Aqueduct, where the friends he made stood him in good stead in organizing the camp work. He arrived at Camp Upton—then a camp in name only—at 8 a. m., June 21, spent the day inspecting the site, and returned to New York that night to recruit an engineering staff capable of laying out and supervising construction operations involving the expenditure of several million dollars in only a few months' time. The fact that the first unit of the Catskill water system was completed recently was a fortunate one for the camp work on Long Island, for

it made available the services of experienced men from an organization which had won a national reputation for the excellence of its engineering personnel.

Five Subdivisions of Work

Major Myers' preliminary analysis of the construction problem indicated that it could be departmentalized under five main subdivisions, as follows: Executive, including inspection and valuation of materials and plant; buildings; sewers and sewage treatment; water supply; roads and surveys. A round-up of Major Myers' acquaintances produced men qualified by training and experience to assume at once charge of each department of the skeleton organization. D. W. Howes was chosen as the Constructing Quartermaster's deputy and given the title "Engineer of Construction." It is noteworthy that every department head has, at some time or other, been engaged in the Catskill Aqueduct construction. The accompanying chart shows the general scheme of organization.



SIDES OF BARRACKS ARE FRAMED AND SHEATHED WHILE LYING FLAT ON FINISHED FLOOR AND THEN—

With these men as a nucleus, the subordinate positions were quickly filled. The rush character of the work made it out of the question to go through the usual time-consuming process of civil-service examination. A man is hired on authorization from the Constructing Quartermaster. The camp work is not a training school for young engineers, and if a man cannot jump right into the work assigned him he is replaced by someone who can.

The important thing about the engineering organization at Camp Upton is its smooth-running quality—remarkable in a brand-new machine. The resulting teamwork, however, is due to the fact that all of the department heads had worked together on the Aqueduct, and were schooled in a single system of administration and office and field routine.

In addition to his regular staff, the Constructing Quartermaster is authorized to employ other engineers in consulting capacities. As the diagram shows, he receives the benefit of the advice of experts on water-supply and sewerage, heating, electric lighting, and roads.

The site of Camp Upton is along the backbone of Long Island, about 60 miles distant from the Pennsylvania R.R. terminal in New York City. It is about two miles north of the single-track line of the Long Island R.R., and is a comparatively flat area covered with a dense undergrowth of scrub oak and pine, which has made the work of preparing a topographical survey an extremely difficult and tedious task. The only map of the territory available was one of the standard sheets of the U. S. Geological Survey, on which the 20-ft. contour intervals were not close enough to be of much practical value in arriving at a detailed location of the vast wooden city.

Topographical Map the First Need

Before work could be planned, therefore, it was necessary to secure a large-scale topographical map, and on June 23 the first field party, recruited in New York, had set out with equipment to secure the desired information. The general method of procedure was to mark up the area in 500-ft. squares, chop sighting lines

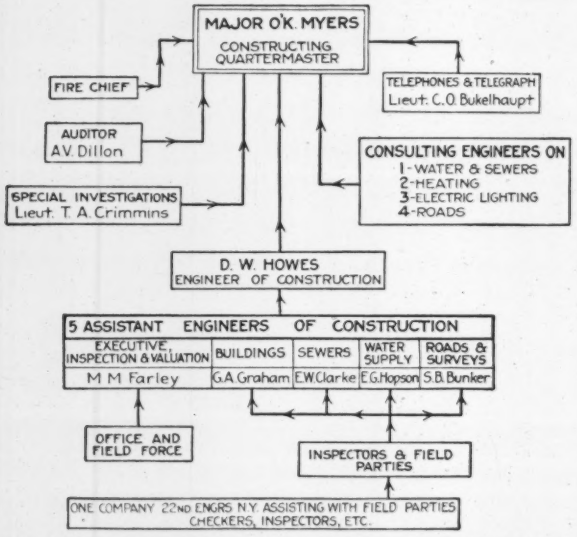
ALL HANDS RAISE THE FINISHED WALL INTO A VERTICAL POSITION—THIS SCHEME OF CONSTRUCTION ELIMINATES ALL SCAFFOLDING

through the brush along these rectangular coördinates, and take topography with transit and stadia. As a result of these operations, it was found necessary to change the tentative location of the camp which the Constructing Quartermaster had originally selected on the basis of the first small-scale map. The new location will place all buildings on areas well above ground water and will effect important savings in the delivery of sewage to the treatment works by eliminating a considerable amount of pumping.

The final location of the cantonment buildings is shown upon the accompanying plan. Owing to the flatness of the country it was possible to follow almost exactly the standard camp layout of the War Department as described in *Engineering News-Record* of July 5, page 8. The buildings will be arranged in groups to form a figure U, with legs almost 2 miles long and an open space or aisle 1000 ft. wide, running down the center. On a hill near the center of this expanse will be located the headquarters of the Commanding Officer.

Transportation a Big Problem

There are practically no local conditions favorable to rapid construction on a large scale. All material must come in over the single-track line of the Long Island R.R. The few vehicle roads in the vicinity of the camp were merely narrow country roads, unsurfaced, and have already been deeply rutted by the unexpected volume of motor-truck traffic which they have been called upon to carry. The road between the railroad station and the camp has been widened and road hones



THE ENGINEERING WORK AT CAMP UPTON IS DEPARTMENTALIZED UNDER FIVE MAIN DIVISIONS—ALL DIVISION HEADS HAD PREVIOUSLY WORKED TOGETHER IN THE SAME ORGANIZATION

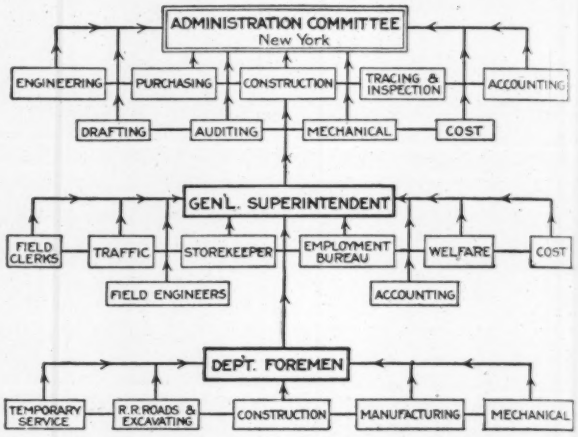
are sent over it periodically, but at the time of my visit to camp the solution of the big road problem had not advanced very far.

There is, of course, no local supply of materials or labor, and no facilities for housing the men. The plan is to billet the contractor's forces in the barrack buildings, as fast as they can be completed, but the 1600 men which the Thompson-Starrett Co. had on the job early this month were living in canvas tents.

The water-supply problem, which caused so much trouble at Camp Whitman, N. Y., when the New York militia forces were mobilized last year for service on the Mexican Border, is a comparatively simple one at Camp Upton, for wells already sunk indicate a plentiful supply of ground water of excellent quality adjacent to the camp site.

Terms of Contract

Like all the other National Army cantonments, the Camp Upton work was let on a percentage basis. The terms of these contracts were explained in *Engineering*



HOW THE CONTRACTOR HAS ORGANIZED HIS FORCES

News-Record, July 5, page 43. In no case is the total percentage payment to exceed $250,000.

The contractor is paid whenever materials are delivered and vouchers prepared and submitted to the Constructing Quartermaster. This may be daily. The idea is to take advantage of discounts. There is a monthly payment to take care of small items and to clean up the books. The Constructing Quartermaster makes the payments to the contractor, reimbursing him for the cost of the work and cost of material, plus a sum equal to 3½ per cent. on these two items. The remainder of the fee above 3½ per cent., depending on the total cost of the completed work, is withheld and will be paid upon final completion of the work.

Rental Allowances

Except in unavoidable cases, the practice of subletting work is prohibited, in order to prevent two profits for the same work. Each contract contains a schedule of rental rates for equipment. A few of the daily rates specified are as follows: Clamshell bucket, $2; boiler and two-drum engine, $3; dump wagon, 25c.; narrow-gage locomotive, $5; mixer, with boiler, side loader, $4; 10-in. centrifugal pump, $3; drop pile-driver, $1.50; rail per ton, 6c.; steam shovel, $30; transits, 50c.; automobiles, $5. The Government stands all expense connected with the equipment, including freight and repairs. It is expected that the ultimate cost of the Camp Upton work will be between $3,000,000 and $4,000,000.

On Aug. 2 the Thompson-Starrett Co., for whom A. G. Moulton is acting as general superintendent, had about 1600 men on its payroll, although this number will be

Seven Stages in the Construction of Wooden Barracks

1. Batterboards for buildings are set accurately by survey parties. 2. Lumber is delivered to job by motortrucks. 3. Portable sawmills trim lumber as required. 4. Into these holes go the chestnut posts which serve as foundations for barracks. 5. This is the first stage of construction—putting on flooring and building sidewalks in horizontal position. 6. Sides up and roof beams in place. 7. Building complete, except for doors and windows

increased to about 12,000 when the work gets into full swing. All labor is supplied through the contracting company's special New York office on West 32nd St. The General Superintendent at the camp sends in his requisitions for labor to the New York office and the men, as fast as they can be secured, are shipped out to the job, sometimes in special cars or train.

Double Check on Men's Time

The system in force for keeping track of costs involves a double check on the labor force, once by representatives of the Quartermaster Department and once by the contractor. The two forces of checkers make their rounds separately, and each workman's card is punched twice daily. The labor force works one 10-hour shift a day, although at times it is necessary to employ night crews to unload material from railroad cars. Common labor is paid $3.75 a day, 75c. of this amount being required for three meals a day at the commissary housed by a big circus tent.

Building Wooden Barracks

For the delivery of lumber and other materials used in the construction of the barracks buildings, there have been built two railroad sidings from the Long Island track, one for permanent camp service and the other only for the construction period. The latter extends approximately along the longitudinal axis of the huge letter U which will be formed by the completed structures, as shown in the plan. Freight cars are spotted on this siding as near the building construction as possible, and the lumber is unloaded and carried to the various points of use by motor trucks and teams. For this service a United States Army motor-truck company, consisting of about thirty Peerless trucks, is available for the contractor's use. In addition, a number of horse-drawn wagons have been provided, as well as lighter Autocar trucks. An experiment is being made in the use of industrial tracks and cars for the delivery of lumber and other supplies from the freight cars to the points of building construction, but at the time the work

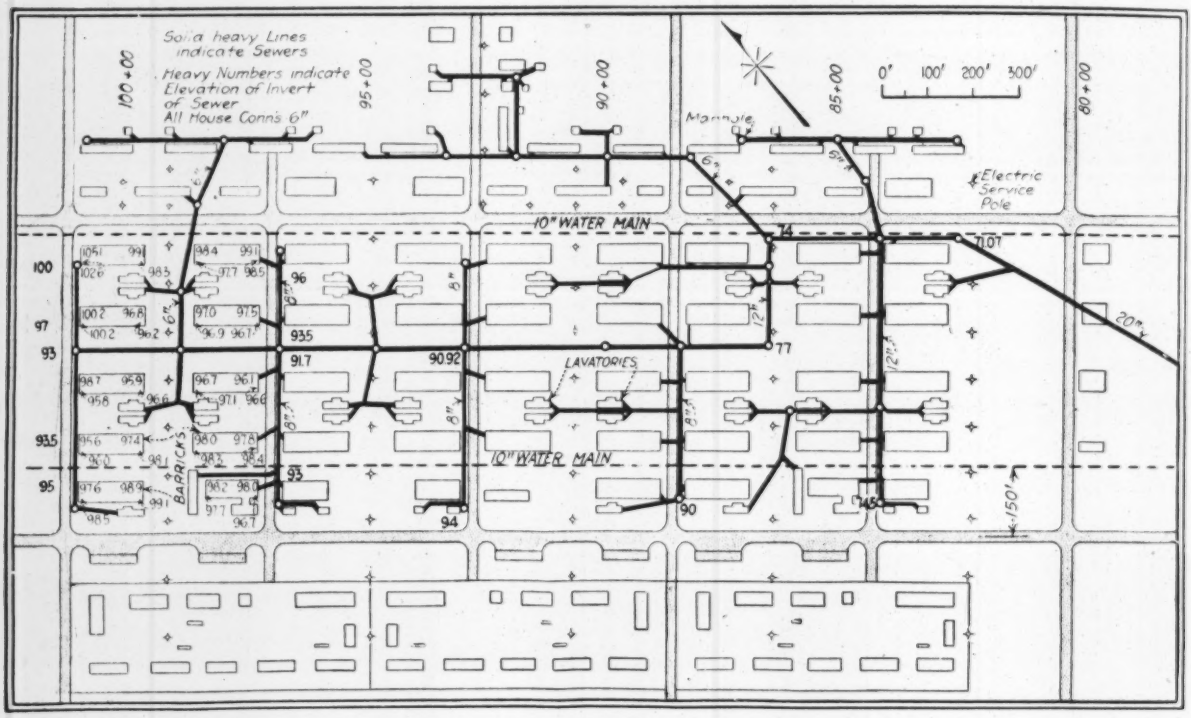
was visited the transportation system had not been developed to a point which would indicate the relative merits of motor-truck and industrial-railway transportation.

Barracks Sides Built Flat on Finished Floor Are Raised to Vertical Position

The standard barracks unit, two stories high, measures 140 x 43 ft. in plan, overall, and its details are shown in the drawings reproduced in *Engineering News-Record* of July 5, page 9. In constructing them, the Thompson-Starrett Co. has adopted a scheme which eliminates the use of scaffolding. Wooden posts are sunk in holes several feet deep to carry the sills and floor joists. The next operation is the laying of the rough flooring. Upon this flooring the two sides of the structure are framed, and upon the studding, lying flat on the floor of the building, tar paper and the wooden sheathing for the sides is nailed. In other words, the sides of the building are put together, complete, in a horizontal position rather than in the vertical position which they occupy in the completed structure. When the pair of side walls is finished, snubbing lines are attached, at intervals, along the outer edge, as the wall lies flat on the flooring, workmen are lined along the inner edge every few feet and at a given signal raise the wall upward into its vertical position, where it is held by a temporary bracing until the other side wall and the end walls can be raised into place in the same way. This scheme of construction, according to the contractor's representative, is a great time saver, as it not only does away with the use of scaffolding but also secures faster work on the part of the carpenters, who are enabled to do all framing and nailing of siding boards at ground level. The construction of the buildings is in charge of G. A. Graham, assistant engineer of construction.

Water Supply Through Wood-Stave Pipe

The camp water supply will be obtained from fifteen 8-in. driven wells located about 3 miles from the nearest camp building, as shown on the accompanying plan. Tests have indicated that each well can be counted upon for a minimum output of 150 gal. per minute. A pumping plant of three centrifugal units delivers into a 14-in. wood-stave pipeline 13,200 ft. long, extending uphill to four elevated tanks of redwood, each having a capacity of 200,000 gal. The lift is about 125 feet.



TYPICAL ARRANGEMENT OF VITRIFIED PIPE SEWERS FOR A THREE-REGIMENT GROUP OF BUILDINGS

Although the elevated tanks are high enough to supply most of the camp area by gravity, it was decided to increase the pressure to cover periods of maximum use and for fire-protection purposes. With this end in view, a booster station is provided below the elevated tanks.

All of the water-supply system will be distributed through wood-stave pipe, with a minimum cover of 2 ft. to provide against freezing and against crushing by heavy motor-truck loads. The trench for the pressure line uphill from the pumping station No. 1 is being dug by a Parsons trench excavator. This machine, reinforced by others, will also be used on the distribution system and on the trenches for the sewerage system. The construction of the water-supply system is in charge of E. G. Hopson, assistant engineer of construction.

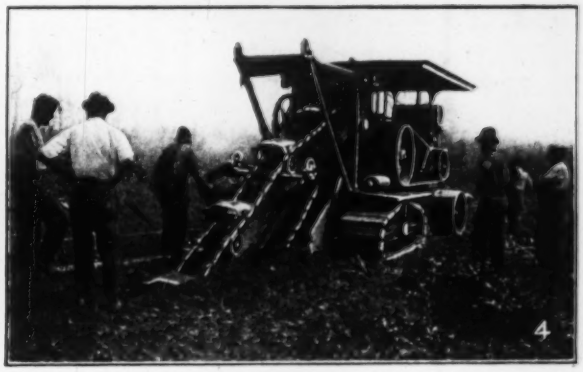
Sewerage and Sewage Treatment

The sewerage system is designed to handle a maximum flow of 10 cu.ft per second. It will consist of vitrified clay pipe, from 8 to 30 in. in diameter. About

one-half of the flow will have to be pumped. The United States Army makes certain standard assumptions regarding the amount of sewage produced by military units, which is summarized in Table I. This table is based on the assumption that the maximum flow from the entire cantonment at any time will be equal to the maximum flow from one brigade plus the normal flow from all other units. Trunk and outfall sewers severally should be designed on this basis, according to War Department instructions. For example, if there are two trunk sewers, one receiving sewage from five

Getting Water Supply to Camp

1. UNLOADING WOOD-STAVE PIPE
2. PUTTING DOWN 8-INCH WELLS
3. MOTOR TRANSPORT FOR PIPE DELIVERY
4. TRENCHING FOR PIPE LINE



units and the other from seven units, these trunk sewers will have respective capacities of 5.5 and 6.5 cu.ft. per sec., while the outfall sewer receiving the flow from both trunk lines should have a capacity of 9 cu.ft. per second.

TABLE I. SEWER DATA, U. S. ARMY SPECIFICATIONS

Regts. of Infantry	Flow, Cu.Ft. per Sec.	Regts. of Infantry	Flow, Cu.Ft. per Sec.
1	1.5	8	7.0
2	2.0	9	7.5
3	4.5	10	8.0
4	5.0	11	8.5
5	5.5	12	9.0
6	6.0	13	9.5
7	6.5	14	10.0

The grades at which the sewers are laid are such as to produce a velocity of 2½ ft. per sec., which is considered to be self-cleansing. The regiment of infantry is the basic unit used in army camp sewer design.

Typical Sewer Layout

A typical arrangement of sewers for a three-regiment group of buildings is shown in the accompanying drawing. The house connections are uniformly 6 in. in diameter, the branch lines 8 in., and in this case the connecting mains 12 in. The latter deliver into a 30-in. outfall line. The buildings are so arranged that the kitchens are all on the street ends, thus allowing for economy in the use of pipe.

The pipe will be laid in trenches excavated by machine as soon as the building operations have progressed sufficiently to allow the trenching work to proceed. The pipe will be laid with cement joints and with a minimum earth cover of 2 ft. At road crossings, where heavy motor-truck loads are liable to be superimposed upon the tile pipe, the latter will be encased in shells of concrete. An important detail of the design is that both sewer and water-supply lines are offset from the roads, so that the maintenance and repair of the subsurface structures will not block highway traffic.

The following minimum grades have been established for the sewer lines: 6-in. diameter, 0.5 per cent.; 12-in. diameter, 0.23 per cent.; 20-in. diameter, 0.14 per cent.; 30-in. diameter, 0.07 per cent.

Sewage Treatment Plant

The disposal plant is located about one-half mile northeast of camp, and consists of duplicate covered septic tanks, each 100 x 25 ft. in plan and 8 ft. deep. These tanks are of standard design furnished by the Quartermaster Department of the army. In each tank are four hopper-bottomed pockets, from which the accumulated sludge will be discharged by gravity onto sludge-drying beds. As a matter of fact, it is expected that the plant will be called upon to deal with very small quantities of sludge, inasmuch as the bulk of the solids will be fecal matter, which will break up and decompose.

The tank effluent will be distributed by wooden troughs to thirty acres of slow-sand filter with 6- and 8-in. under-drains leading to a nearby swamp. The filter area will be divided into beds approximately 1 acre in area. The filter beds will utilize the natural layers of sand to at least a depth of 6 ft., through which the settled sewage will pass. The construction of sewerage systems and disposal works is in charge of E. W. Clarke, assistant engineer of construction.

How Materials Are Checked

The adoption of the percentage form of contract for all of the Government cantonment work has necessitated the installation on each job of a systematic method of auditing by expert accountants. There is a central auditing bureau in Washington and a field auditor for each contract; the Camp Upton work is in charge of A. V. Dillon. In order that a check on materials may be had, the contractor is required to submit three copies of all orders for materials or supplies. One of these goes to the material inspector, one to the receiving clerk, who checks the quantities, and the third to the voucher clerk for the field auditor's files. On the third copy all prices and extensions are verified.

The contractor must sort out invoices immediately on their receipt and give the right of way through clerical channels to those on which a cash discount may be had. Duplicates of invoices go to the field auditor, and are, by his staff, compared with the original orders. The latter, meantime, have been checked as to prices and extensions, so that there is practically no delay in certifying to the correctness of any invoice. If the order is not complete, the field auditor makes up dummy receiving sheets, and when enough of these dummies have been made to account for the entire order, the bills are O. K.'d.

When the contractor accumulates twenty or more invoices he makes up a voucher sheet and presents it for reimbursement, having already paid the sums represented by the various invoices.

At the end of each month the contractor submits a statement of labor and materials, which is checked from the field auditor's records. Payment includes the balance due plus 3½ per cent. on all money paid to the contractor during the month. The remainder of the percentage fee due the contractor is retained until the work is completed.

When a piece of heavy machinery is received on the job it is immediately evaluated by representatives of the Constructing Quartermaster and a rental value fixed. If the rental paid at any time shall equal the total valuation of the machine, further rental stops and the machine becomes the property of the Government. Another contract stipulation is that the Government may take over any machine by paying the difference between its assessed valuation and the rent already paid.

Roads

A separate contract for road construction within and adjacent to the camp site was let to the Barrett Co. The camp site will be served by systems of primary and secondary roads, each of 34-ft. width. These roads, of which the primary system includes eight miles and the secondary system twelve miles, will be tar-surfaced by the penetration method. It will be necessary to import all stone, as no local supply is available. Practically no drainage troubles are anticipated, as the Long Island soil is sandy and surface water will seep through it readily. All roads, however, will be built above the normal ground level, with water mains and sewers at the sides. It is expected that these roads, when the site becomes an army training camp, will be subjected to exceedingly heavy motor-truck traffic, and a maintenance force will be kept on the work continuously. The road work is being handled for the Quartermaster Department by S. B. Bunker.

A New Kind of "Government Job"

By the time this article appears, building construction, which had hardly got under way early this month, will be in full swing. The fact that 25,000,000 ft. of lumber will be used for the barracks, storehouses, and other structures, and that a complete water-supply system, sewerage system, and disposal works, and a network of bituminous-surfaced roads, are required, gives one some idea of the task which the engineers and contractors are facing. The man who has always regarded "Government jobs" as sinecures gets a rude shock when this sign confronts him on the door of the engineer's shack:

> MEMORANDUM
> Office hours of this organization are as follows:
> 8 a.m. to 6 p.m.
> Field parties are expected to be out in the field during these hours. Inspectors' hours in the field are to correspond to the contractor's working hours.
> (Signed) D. W. HOWES,
> Engineer of Construction.

In the early days of the job, a new draftsman approached M. M. Farley, assistant engineer in charge of all field-office work:

"What style of lettering do you want on this drawing?" he asked.

"Anything that I can read and that you can do the quickest," Farley replied.

And there you have the spirit of the Camp Upton job.

No Refinements on War-Zone Roads

The refinements of road building receive scanty attention along the battle line in France. In the early days attempts were made to use telford foundations in damp places, where suitable stone could be obtained. The stones were set on edge and wedged with small stones. In ordinary times such a foundation is then consolidated by running a roller over it. But behind the trenches no roller could be used. It would rarely have been possible to get it there and it would have been too much in the way of guns and ammunition wagons to be allowed there in the rush of a forward movement. So instead of a roller with broad wheels, the much narrower wheels of heavy gun carriages and limbers were dragged over the stones and hammered them down into the mud. Had it been possible to cover the stones immediately with broken bricks or building refuse the foundation might have proved satisfactory, but under the existing conditions it was a hopeless failure. So instead of wedging the stones upright, the army road builders finally laid them flat. The traffic shook these flat stones down quickly—more being placed on top.

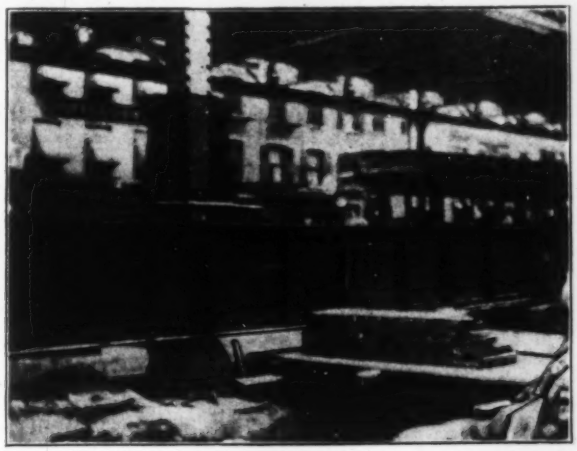
Water-Pipe Blowout Undermines an Elevated-Railway Column

Paved Street Is Undisturbed and Elevated Railway Only Slightly Depressed by Cavern Forty Feet Long

By James F. Fouhy
Section Engineer, Public Service Commission, New York City

A RECENT water-pipe blowout under an elevated-railway column in New York City was surprising in that a cavern some 43 ft. long and 5 to 15 ft. wide was dug out underneath the heavy paving of the street and was not discovered until a public-works inspector detected it in tracing the cause of the flooding of a near-by cellar. A slight settlement of the column was noticed, but not enough to cause any effect on the elevated-railway traffic.

At the corner of 10th St. and Sixth Ave., a 4-ft. circular brick sewer of many years' standing runs diagonally across the line of the Sixth Ave. elevated through the footing of one of the railway columns. A 24-in. water main passes through the sewer just under the railway. A 24 x 12-in. four-way on this low-pressure water main had a blowout, and the water escaping demolished the encircling sewer and carried away the surrounding earth, opening up a cavern about 43 x 15 ft. in plan. As stated above, no sign of the disturbance was noticeable on the street. The pavement of 3-in. sheet asphalt on 8 in. of concrete remained in place, carrying the heavy street load until the cavern



CAVERN CAUSED BY WATER-MAIN BLOWOUT UNDER RAILWAY COLUMN FOOTING

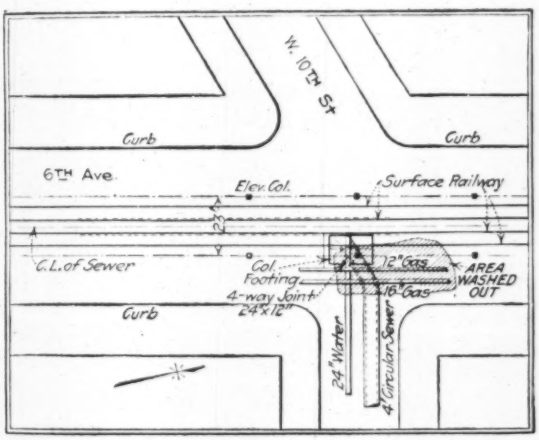
was discovered. Traffic was immediately suspended on the elevated railroad and on the adjacent street. An examination of the subsurface condition was made and provisions immediately begun for shoring.

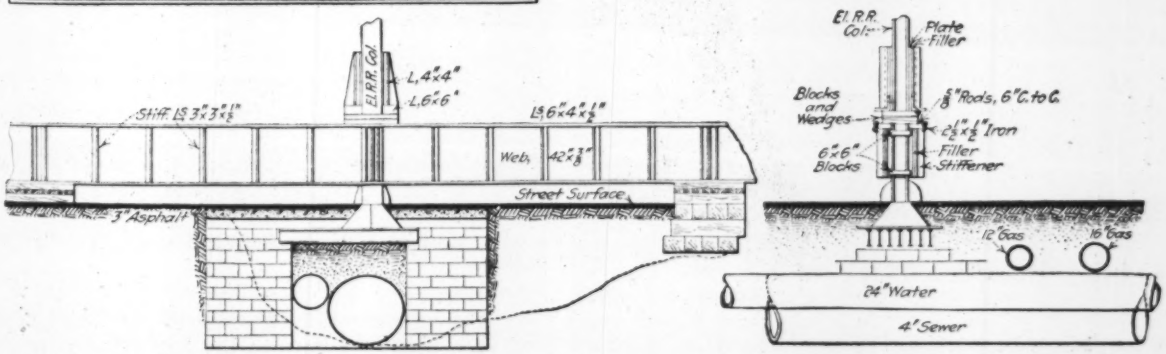
Location of Column and Mains

The accompanying plan shows the location of the column and its footing and the near-by water, gas and sewer line. In the original construction, as shown there, I-beams supported on piers located on either side of the sewers distributed the elevated-column load to the ground.

In the repair, heavy girders were placed spanning the cavern and supported on blocking on the street and partly in the cave-in. The column was then jacked onto these girders through the medium of riveted outstanding angles and plates. The shoring was completed and the elevated-railway service resumed at 4 a.m. of the day following the washout—that is about 12 hours after the cave was discovered. Trains, however, were obliged to pass over the settled column at a much reduced speed. It is fortunate the trouble was discovered early in the afternoon, for elevated-road traffic is much heavier beginning about 5 p.m., when the headway between trains is much reduced. At such a time a serious accident might have occurred.

In the reconstruction the curve has been taken out of the sewer, and it is carried west on a straight line to connect with the Sixth Ave. trunk sewer.





WATER-PIPE BLOWOUT UNDERMINES ELEVATED-RAILWAY COLUMN—STREET SURFACE NOT DISTURBED

What Are the Prospects of Navigation on the New York Barge Canal?

Full Depth Is Practically Available from Lakes Ontario and Champlain to Tidewater and Many Terminals Are Ready, but Lack of Boats and Public Interest Postpones Use at Critical Time

BY FRANK C. WIGHT
Associate Editor, Engineering News-Record

THESE are promising times for the inland waterway. The traditional opposition to its use, whether based on sound economics or on personal profit, has faded away before the overwhelming demand for freight carriers and the insufficiency of the railroad. Governmental assistance is active; and railway obstruction, if not passive, is at least less forceful than in the past. If success for inland-waterway transportation is ever to be possible, it should be now.

It so happens that the New York State Barge Canal—historically and economically the most important artificial waterway in the country—is nearly completed at this time. As a piece of engineering, that canal has had the wide publicity among engineers befitting one of the largest projects of the generation. As a navigation unit, little has been said about it, because until recently its navigable stretches have been incomplete and scattered. Report on the present conditions of the canal and the prospects for its completion, with the conditions of navigation now and in the immediate future, should be of timely interest.

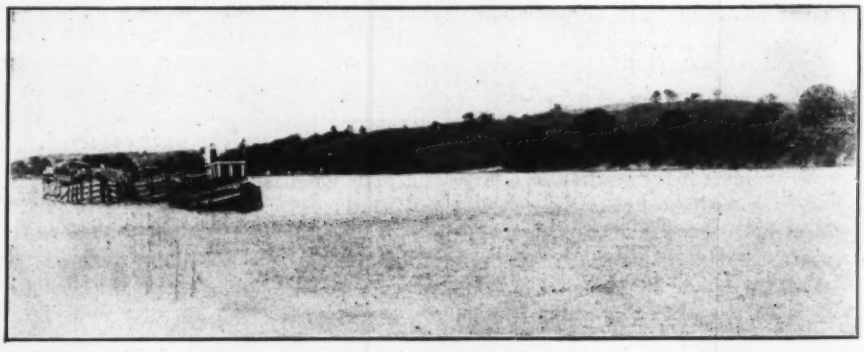
The Barge Canal, authorized by a vote of the people of the state in 1903, connects Lakes Erie, Ontario and Champlain with tidewater by a water channel capable of carrying boats and barges up to 2000 tons capacity. The main line extends from the Niagara River at Tonawanda, east to the Hudson at Waterford; the Oswego branch provides a connection from the main line just west of Oneida Lake down to Lake Ontario at Oswego; the Champlain branch carries over a summit level between Whitehall, on Lake Champlain, and the Hudson River. A branch ties in Lakes Seneca and Cayuga.

Throughout the whole canal length, a total of 440 miles, the minimum depth is 12 ft. and the minimum sections vary as follows: In rock, 94-ft. bottom width for full depth; in earth, 75-ft. bottom width, with 1 on 2 side slopes, giving a 123-ft. surface width; in rivers, 200-ft. bottom width for full depth. The locks, of which there are 57, are 311 ft. long, 12 ft. deep over miter sills, and 45 ft. wide. Overhead clearances are fixed at a minimum of 15½ ft. above the water level.

The entire design and construction of the canal system has been under the direction of the State Engineer and Surveyor, which office has been held by F. A. Van Alstyne, 1904 to 1906, Frederick Skene from 1907 to 1908, Frank M. Williams from 1909 to 1910 and 1915 to the present, and by John A. Bensel from 1911 to 1914.

The canal follows the general route of the original New York State canals, with the important exception that wherever possible the existing rivers are utilized

THIS IS A LAND CUT SECTION OF THE CANAL WHERE THE WATER SURFACE IS 123 FEET WIDE AND THE BOTTOM WIDTH ONLY 75 FEET



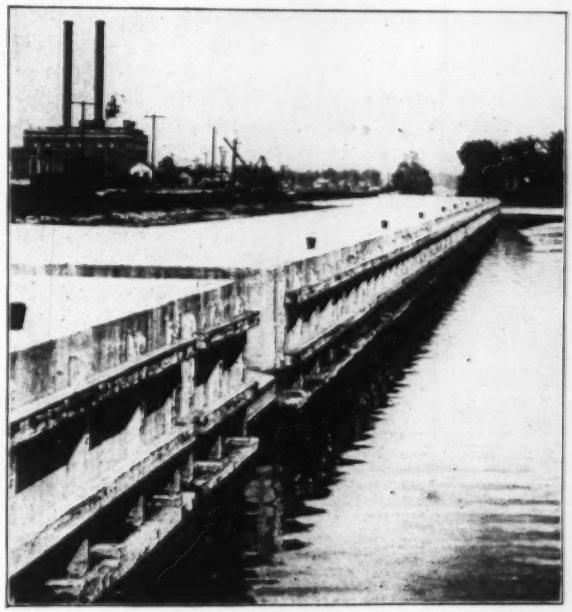
THE SAME BOATS THAT NAVIGATE THIS HUDSON RIVER SECTION MUST ALSO PASS THROUGH THE NARROW WATERWAY ABOVE

in place of the land cut of the early day. About 72% of the whole system is in river or lake channel. The main line approximates in line the old Erie Canal, work on which was started at Rome just 100 years ago. Instead of starting at Buffalo, however, as the old Erie Canal did, traffic will follow the Niagara River up to Tonawanda, where the Barge Canal starts. From Tonawanda east to Palmyra the canal is practically an enlargement of the old Erie Canal, which was dug in a land cut, with the exception of a section at Rochester where the new canal passes a few miles south of the city, utilizing the Genesee River for a branch connection down to Rochester.

Eastern Section in Canalized Rivers

From Palmyra east to the Hudson numerous rivers are canalized for the most part, although in straightening bad curves in some short sections land cuts had to be made. Going east, the first rivers are the Clyde and the Seneca; the latter empties into the Oswego River at Three Rivers, and from that point north the Oswego Canal continues to Lake Ontario as a canalization of the river. From Three Rivers to Oneida Lake the Oneida River is followed and a long, open navigable waterway afforded through the lake to Sylvan Beach, where a land cut and a small creek are utilized to just beyond Rome, from which point the Mohawk River and its tributaries are canalized clear down to Crescent, just northwest of Waterford, where a flight of five high locks drops the canal into the Hudson.

The old Erie Canal from Clyde east to Rome is in a more southerly location, passing through Syracuse, which in the new system will be reached by a branch through Onondaga Lake. From Rome to Cohoes the Erie Canal is south of the Mohawk River and reaches the Hudson River through a long flight of locks at Cohoes. The Champlain Canal is a canalization of the Hudson River as far north as Fort Edward, from which point it utilizes small streams and land cuts down to Whitehall, on Lake Champlain. The Cayuga and Seneca Canal, connecting up the lakes bearing those names with



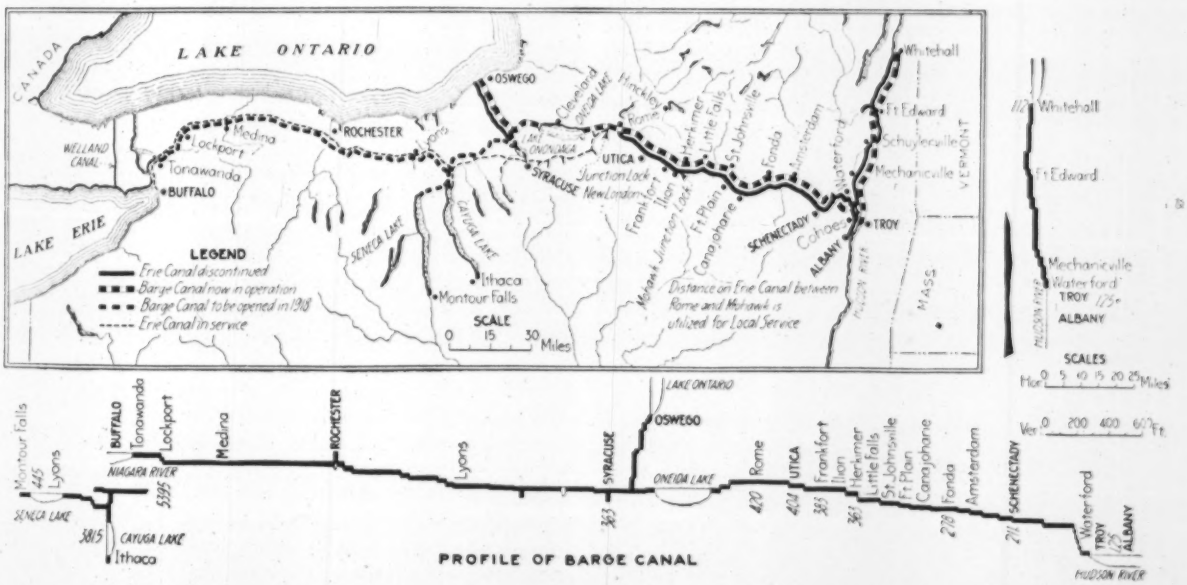
THE ALBANY RIVER TERMINAL IS A TYPICAL WALL

the main-line canal, is a canalization of the Seneca River and enlargements of old canals existing on about the same line.

As will be noticed from the profile, the canal drops by a series of locks from Lake Erie to the low level north of Syracuse where the Oswego Canal drops still farther to Lake Ontario. The summit level east of the Oswego Canal is at the Rome level, which is fed by the Delta reservoir northeast of Rome. The Rome-Hudson section is still further fed by a reservoir at Hinckley, north of Herkimer.

Condition of the Canal Today

The new system is now open for its designed width and for a draft of 8 ft. from Lakes Ontario and Champlain to tidewater. That is, the Champlain Canal is open for its full length; the Oswego and Erie Canals



MAP SHOWS THE CONDITION OF THE NEW YORK STATE CANALS ON AUG. 15, 1917

AT TROY THE RAILROAD TRACKS ARE RIGHT ALONGSIDE THE TERMINAL DOCKWALL ON THE HUDSON

are open from thence eastward to the Hudson. In these sections the designed depth of 12 ft. is available at all but a few places where shoals have appeared since the full depth was made. On this account the Superintendent of Public Works has never changed the 8 ft. draft restriction made at the opening of navigation this year.

From Rome, west to Lake Erie, canal navigation still follows the old Erie Canal. That canal is in operation from the junction lock in Rome to a junction lock at Mohawk, just west of Herkimer, but is utilized there for only local traffic or for water-supply purposes. From the junction lock at New London, just west of Rome, the Erie Canal is in operation along the old line to Buffalo with an allowable depth of 6½ feet.

The section of the Barge Canal west of Rome is held up by several local pieces of construction, all of which are to be completed with the opening of navigation in 1918. These pieces of work are some railroad crossing revisions around Tonawanda, the Genesee River improvements at Rochester, some channel enlargements at Lyons and Clyde, and the removal of the old aqueduct carrying the Erie Canal across the Barge Canal at Montezuma, north of Cayuga Lake. Practically all the structures on the whole Barge Canal are now completed.

Many of the Terminals are Completed

Terminals on the old canal system were of minor importance. On the new waterway, however, with its prospective large boats and power towing, the facilities for transferring freight to land assume great importance. The original vote did not provide enough money for the very necessary terminals to the canal, so in 1911 through a referendum the State of New York appropriated $19,800,000 to be spent on terminals. With this sum and with other money diverted from the original appropriation, terminal construction has been proceeding during the past four to five years.

The terminals are of two general types, the marginal dock wall and the pier. In the dug canal and in the rivers a marginal wall in a slightly widened section of waterway is the standard. In lakes, however, and around New York City, where transshipment from larger boats to canal boats is to be expected, typical piers have been designed and built. These terminals are located all along the canal and also in and around New York City and up along Lake Champlain. Applications have been made for some terminals along the Hudson River below Albany, but so far none have been commenced.

At present a considerable number of marginal terminals are in use though not entirely equipped. They are located at Albany, Troy, Mechanicsville, Schuylerville, Thompson, Fort Edward, Whitehall, Crescent, Schenectady, Amsterdam, Fonda, St. Johnsville, Fort Plain, Little Falls, Herkimer, Ilion, Frankfort, Utica, Rome, Cleveland, Eastport, Ithaca, Lyons, Medina, Lockport and Tonawanda. Other marginal terminals are under construction at Mott Haven in New York City, Cohoes, Canajoharie, Oswego, Rochester and Buffalo.

Pier terminals have been completed at Plattsburg and Port Henry on Lake Champlain, and Oswego on Lake Ontario. There are under construction the revision and reconstruction of Pier 6 on the East River of New York City, and new piers at Gowanus Bay in Brooklyn, N. Y.; Rouses Point on Lake Champlain, Syracuse on Lake Onondaga, and Buffalo on Lake Erie. Some other terminals are under design and probably will be put under construction during the coming season.

Little Terminal Machinery Has Been Installed

In all of these terminals what has been completed is merely the structure; that is, a wall or a pier, in some cases paved, but in most cases only filled, immediately adjacent to deep water, with its approach just as the local authorities were pleased to leave it—in some cases in very poor condition. As far as equipment is concerned, nothing has been installed except a few small derricks, mostly hand controlled, and in a number of terminals a temporary wooden freighthouse, painted in every case a conspicuous yellow which distinguishes it in any group of buildings. Bids have recently been opened for some package-freight handlers to be installed in a few loca

tions, where such freight is expected, and designs are under way for more elaborate freight-handling machinery. Installing this machinery and constructing permanent freighthouses, however, are being deferred until prices reduce somewhat and traffic seems to demand such improvement.

The terminal facilities are so far deficient in their relation to rail connection. In Troy, the dock wall is fortunate in its location, in that it has the tracks of two railroads immediately alongside, so that the transfer of freight can be readily and cheaply made from rail to boat. The wall at Buffalo, too, will be carried up to rail connection, and it is possible to develop rail connection to the Syracuse piers now under construction. At the other locations, however, rail connections have not been provided. It is of course hoped that in the future the terminals in most of the cities will be tied up to railway connections, so that the canal may be used to serve not only the canal banks, but also through localities not on the canal.

Towing by towboats is necessary on the canal, as there are no towpaths. While the state provides towboats which can be rented at a fixed charge (determined so as not to make a profit, but merely to take care of necessary expenses), it is expected that a large part of the travel on the canal will be by towboats owned by the operators. No charges are made for the use of the canal, except for towing. The terminal charges are designed not to make money, but to afford some control over the use of the terminals, which otherwise might be turned into mere storage stations.

State Control of the Canal Is Assured

The operation of the canal will be under the direction of the Superintendent of Public Works, as is the operation of all the other canals in the state. He maintains the canal in a state of structural efficiency, keeps the channel to the proper depth and width, mans the locks and dams, operates the state-owned towboats, and superintends and operates the terminals.

By far the most important job before the superintendent in the immediate future is the work which will come under the jurisdiction of a new officer to be known as Canal Traffic Manager. This is a position which formerly did not exist, but which the necessities of traffic and rail competition make necessary if the new canal system is to be of its expected value. The new officer will be in charge at first of publicity. He will make the canal known to the people of the state, who, strangely enough, do not seem to realize its existence. He will, through whatever means are available, try to encourage individuals to use the canal. He will, working through boards of trade, chambers of commerce and the city governments, try to get individual cities to encourage their citizens to use the canal and build proper approaches to the terminals provided by the state. It will be his further duty to encourage the organization of corporations owning and operating a large number of boats and, finally, to get business for the canal just as does the freight agent for his railroad.

This officer was only appointed a few weeks ago, and he has not as yet been able to do more than organize his office and plan a campaign. It is unlikely that his work will begin to tell until next season.

The preparation for the use of the Barge Canal is tied up to a question which involves the very existence of an enlarged canal. What type of boat is to be used?

In the years before the referendum of 1903 there was an historic fight between the barge-canal and the ship-canal adherents, between those who wanted the canal to carry 1000-ton barges from Buffalo to tidewater and those who wanted a deep waterway capable of floating a seaworthy ship which could navigate both lake and ocean. The former scheme demanded transshipment at lake and ocean ports and naturally had the greatest number of advocates in Buffalo and New York, where transshipment charges would be paid. The latter involved a tremendous amount of expensive construction and would have benefited the general economic condition of the country rather than of New York State or any of its cities. The barge canal won out.

What Boats Are Being Built?

As originally planned, that canal had the same water sections as have been built. The locks, however, were only 28 ft. wide. The water section and the lock section were both predicated on the use of a 1000-ton barge of 25-ft. beam and drawing 10 ft. of water, allowing the usual assumption in canal design of 2 ft. of water below the keel. Such a section has a ratio of 1:4½ to the minimum cross-section of the canal proper. For the Erie Canal the ratio was 1:3.4; in the 1840 enlargement of that canal it was 1:4. The barges which it was assumed would be built then, would have fair clearance in the lock and would be able to pass each other in the narrowest section of the canal proper.

After the first designs were made, but before construction had started, locks were changed so as to have a width of 45 ft., which is the width of the old Welland Canal locks, although those locks have a depth over miter sills of 14 ft. against the 12 ft. of the New York State Barge Canal. Ostensibly, the reason given for this change was to permit the passage through the Barge Canal via Oswego of all except the most heavily loaded vessels which could pass through the Welland Canal. In effect, the change automatically enlarged the capacity of the Barge Canal, partly in fact, but more in the minds of those who were planning for its use. It made practicable the use of a barge of a capacity of at least 2000 tons. It did more; it opened up again the possibility of a ship canal, which had been buried a decade ago.

THIS SEAWORTHY SHIP MAY USE THE BARGE CANAL

The result is that there has been a revival of interest in the possibility of building ships which will traverse lake, canal, river and ocean; which can, in effect, load at Duluth and deliver in New York or any ocean port.

The General Electric Co. has had one of its engineers working for some time on a project to utilize a combination lake-and-canal steamer, which will be able to travel between all of the General Electric Co.'s plants; that is, from Cleveland through the canal to Schenectady, thence out into the Hudson and the ocean to Lynn and Norfolk. The project has reached an advanced stage, but no boats have as yet been built. A design recently published in the *General Electric Review* shows a boat 260 ft. long, 43 ft. in beam and of 10- to 17-ft. draft, which is represented as being able to carry a cargo from Duluth to any point on the Atlantic Coast. Such a boat will have hatches and side ports to facilitate the handling of package freight and will also be available for bulk freight. The speed will be 10 knots with 750 hp. applied by electric motors to twin screws, the engines being driven by Scotch boilers over oil burners, furnishing steam to a Curtis turbo-generator.

According to the article, the dead-weight carrying capacity would be roughly 1200 tons on 10-ft. draft, 3000 tons on 17-ft. draft, and available space for cargo would be about 85,000 cu.ft., or the equivalent of 50 box-cars. The General Electric Co.'s program also calls for coal barges to be drawn in tows, for fast 150-ton boats running between Schenectady and New York on short-schedule service. A plan is also proposed by the company for a terminal unit at Schenectady which is to be lined on both sides by walls somewhat after the nature of a lock and the boat, warped into the terminal, to be loaded and unloaded from a 120-ton gantry crane traveling on the two side walls.

One Large Ship Has Been Built

A second project of the same sort, though somewhat of a mystery, is still part way toward development. This is a ship, similar in type to that proposed by the General Electric Co., which has been built by the McDougal-Duluth Co., of Duluth, Minn., and which has already made one trip from Duluth to Montreal through the Welland and other Canadian canal systems. This ship, a view of which is shown, is 258 ft. long, 43 ft. in beam and of 23-ft. molded depth, and will carry 2400 tons on a 14-ft. and 1800 tons on a 12-ft. draft. It is steam-driven and is designed for lake and ocean travel. It has been certified and insured to go anywhere. This ship has a side clearance of 2 ft. through the locks and a vertical clearance (leaving off railing and upper works) of but 2½ ft. under bridges when drawing 10 ft. of water.

The Barge Canal will have 12 ft. of water, but it is intended not to permit traffic of boats drawing much over 10 ft. of water, so that the boat will have to be loaded quite light to go through the canal. The upper works—that is, the cabin, funnel and forward pilot house—are all removable and will be stowed away during the canal passage. The greatest secrecy is being preserved over this craft, but the report is that it is to be used for grain transportation from Duluth, through the Great Lakes and the Welland Canal down the Oswego branch to New York.

It should be noticed that such boats as the ones described have less capacity for canal travel than for lake and that two such boats, just clearing the locks, cannot pass in the land-cut sections of the canal.

The prospects for many new or enlarged barges fit to traverse the Barge Canal are very slight. Boat building for the Erie Canal has not been a prosperous business in the recent past. Most of the shipping being used on that canal is old and decrepit, some little of it with power haul, but most of it using the historic mule. Of course, such boats as already exist can be used on the new Barge Canal in tows of larger number than could pass through the old Erie Canal locks, and it is the desire of the state officials to encourage the use of such boats as much as possible. The great demand for lighters in and around New York Harbor, however, has almost depleted the Erie Canal of its floating stock. A boat goes down the canal under the charge of its captain and owner, reaches New York Harbor and is immediately put in service for lighterage use at a compensation higher than the owner can get by taking it through the canal.

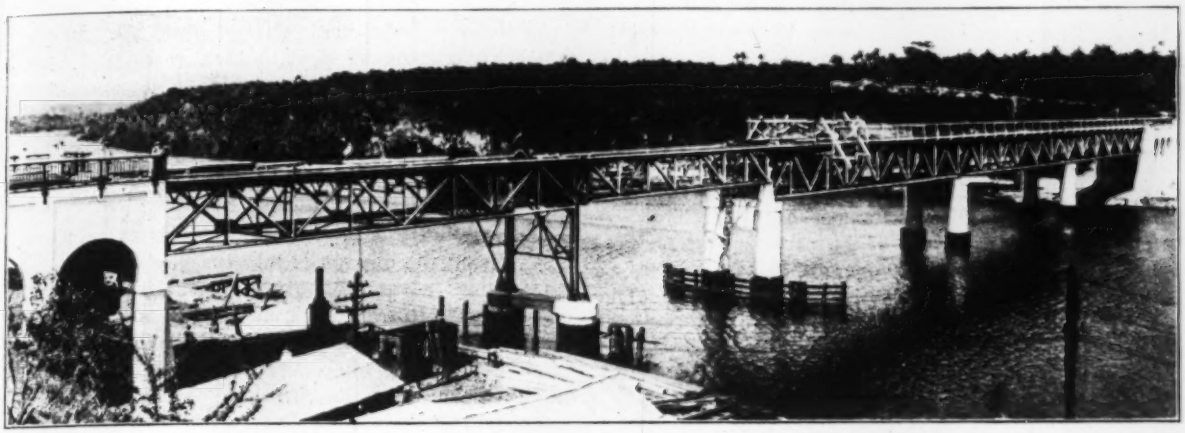
Some few wooden barges of a size profitable to carry through the Barge Canal are under construction, and it is understood that certain steel barges will soon be put on the ways. Steel barges now cost about $60 a ton against $15 a ton in normal times, so that little can be expected toward the construction of such boats, unless the Federal Government steps in to reduce prices.

Freight-Handling Business Needs Reform

The business of handling freight on the old canal was was most primitive. For the most part the boats were owned by their captains, who operated as freelances. Conditions are little better today. In some ways they are worse, because so many of the boats are not now on the canal. There is, however, one large concern engaged in freight handling and forwarding in the new canal. This company owns a number of boats of small size and contemplates building more of the Barge Canal dimensions. It has offices and warehouses where business may be transacted in a manner approaching what is hoped will prevail on the completed canal.

With this one exception any freight shipping on the canal this year can be conducted only by those who are acquainted with the elementary means available. It will be the hardest kind of a job for an ordinary shipper to find boats or to be sure that his freight will have safe or certain transportation. The last legislature passed bills guaranteeing control of the shipping by the Public Service Commission and making mandatory a joint way bill for canal and rail routing so that businesslike transportation conditions should now prevail on the canal system, provided the state officers succeed in persuading men to go into the freight-handling business and other men to make an effort to avail themselves of the lower freight rates canal shipments should offer.

For the present year, however, there is small promise that the New York State Barge Canal will carry even as much freight as has the Erie Canal during recent years. Whether publicity can overcome apathy, and whether the facilities produced by the state will be made use of, remain as yet to be seen. Meanwhile, there is doubtless another pretty fight brewing between the ship and the barge advocates.



Building a Bridge Under Adverse Conditions in San Domingo

Lack of Local Material and of Skilled Labor Do Not Prevent Scheduled Completion of Modern Steel Highway Bridge Across River Into Which Columbus Sailed

By E. S. NEEDHAM
Formerly of Department of Public Works, Santo Domingo

A BRIDGE which was started under the lax overhead conditions peculiar to the equatorial Latin-American republic, continued through a revolution and completed under American military control would naturally seem to offer some differences in construction experiences from those normal to the United States. Such a bridge was recently completed across the Ozama River at Santo Domingo City, and in many incidental features was out of the ordinary. It is worth describing because, in spite of obstructions due to local conditions, the construction was carried out according to schedule.

The bridge is on historic ground. Standing on it and looking toward the sea, there appears on the left bank the ruins of the first chapel in the New World, and opposite on the right are the old fort and the ruins of the palace of Don Diego Columbus, son of the great admiral. In the right foreground is the famous tree to which Christopher Columbus is said to have moored his ships. On the site there had been low-level bridges for many years, but all had been washed away by successive storms. The new bridge, at the high level, contains a modern bascule span which will allow shipping to develop above the bridge site. Small craft can pass under the bascule, the free height above water being 30 ft. The bascule is 85 ft. long and the clear channel is 74 ft. between fenders. Approaching the bascule from the Santo Domingo side is a 98-ft. steel span, and from the other or Daurte side are three 140-ft. steel spans. The total length of steel spans is 610 ft.; reinforced-concrete approaches add to the length 50 ft. on the Duarte side and 66 ft. on the Santo Domingo side, making a total length of 726 ft., or about 220 meters over all. The width of the roadway between curbs is 19 ft., but the design provides for future sidewalks.

During the whole construction the builders were confronted with lack of plant and tools and the reluctance on the part of the native workmen to keep in repair such equipment as there was. Many delays were caused by plant failures due to carelessness or to the poor quality of material that was to be had in the local market. Many tools had to be improvised; for example, the contractor did not have a bar bender and one had to be built from scrap material. Due to the lack of skilled mechanics, ways and means within the capacity of the native workman had to be adopted and often the crudest methods of work used, rather than risk a failure of modern practice.

The Dominican laborer is capable of good results and is willing to learn. The skilled workman has not learned to follow a blueprint, and it was necessary, especially in building forms to make picture sketches of the separate parts for the carpenters, which took considerable personal supervision.

Native Divers Were Used

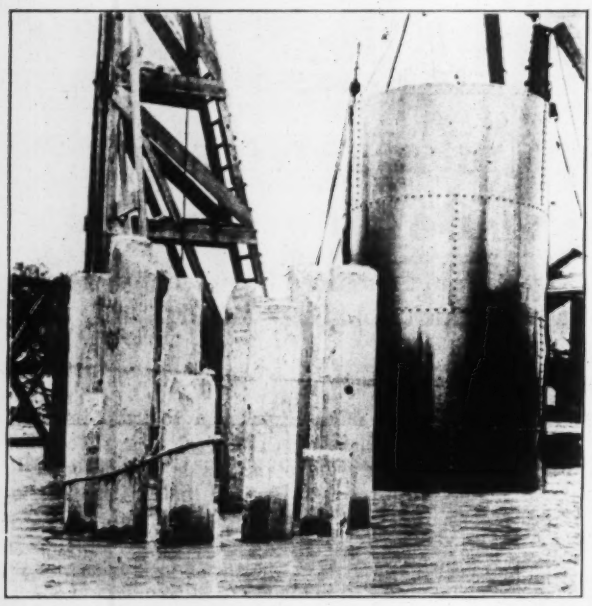
On one pier excavation had to be made by divers. With only the scantiest apparatus, the work was done successfully, though slowly, for the divers, almost without exception, were recruited from among the natives and were induced to go down by the prospect of good wages.

Difficult as it was to be sure of delivery of material from the United States, it was even more difficult to get native timber which was used in the bridge floor and is known as "candelon." Although there were forests of it not 100 miles away, the crude methods of hauling and the lack of mills to cut it, made it almost impracticable. Without highways or railroads to transport it, it came in small cargoes by coastwise sailing vessels and after 18 months of effort enough was procured for the bridge—some fifty or sixty thousand feet board measure.

The three concrete piers supporting the 140-ft. spans are of the cylinder type with reinforced-concrete pile

foundations. The bases extend 3 or 4 ft. below the river bottom, and the bridge seats are at El. 26 above mean sea level. The depth of water is about 20 ft. and increases but a foot or two from tides and floods. The river bed consists of alternate layers of black sand and blue and yellow clays, overlying gravel and black clay and at a depth of 90 ft. a stratum of very hard gray clay. Wooden test piles indicating the stratum of gravel determined the lengths for foundation piling.

The concrete piles were of 14-in. octagonal section, ranging in length from 10 meters to 16½ meters, of 1:2:3 concrete precast in the usual manner. The



GROUP OF CONCRETE PILES DRIVEN INSIDE OF STEEL SHELL JUST REMOVED

reinforcing consisted of eight ¾-in. square twisted bars with ¼-in. square spiral hooping of 12-in. pitch and on an occasional flat ring punch with holes to assist in spacing the main bars. A special basket reinforcement was placed at the head of the pile, consisting of several turns of the same ¼-in. steel at 1½-in. pitch. The effectiveness of this basket in keeping the pile head intact during driving is shown in one of the veins. The driving was done with a No. 3 Warrington steam hammer—having a weight of hammer of 1800 pounds.

In two piers there are 15 and 18 piles respectively in each of the two cylinders of 9-ft. diameter. The cylinders of the third pier are 8 ft. in diameter with 11 piles in each. These take the maximum direct load per pile, which, considering buoyant forces, was figured at 22 tons per pile.

The driving was done in advance of placing the cylinders, and various devices were used to prevent the piles from being driven outside of the required circle. The best results were obtained when the piles were placed through a guide at the surface of the water, made up of two concentric cylinders 5 ft. deep, with spacing blocks between. The pier cylinders were dropped over the pile heads and weighted down about 8 ft. through mud and silt into a clay stratum and were then pumped dry without difficulty with a 3-in. Pulsometer. Experience showed that the cylinders, which were made of $\frac{5}{16}$-in. plates, would not sustain the pressure from the water without, and, to prevent buckling, timber bracing was used inside in the form of triangles which allowed a comfortable space in the center for excavating and concreting.

Pier Stability Increased in Novel Manner

Old rails were used in the pier bases as reinforcing and to bond the pile heads into the pier concrete. The reinforcing in the cross-girder at the top of the pier was designed to transmit a shock from one shaft to the other, and the continuity of reinforcing throughout tends to make the whole pier act as a unit for stability in the direction of the current.

To increase the stability of the piers in the direction of the center line of bridge, there are buried in the bridge seats wrought-iron billets projecting vertically between the ends of the trusses; and the trusses are connected one to the other by 2-in. round steel half-links which pass through slotted holes in the top chord. By this arrangement, a shock is transmitted from any one pier to two others, and in an extreme case the pier which would receive the blow would not be in danger of being knocked out from under the trusses. The bearing plates have slotted holes for expansion, but no sliding occurs on the cast-steel bases, as the piers yield to the movement of the spans.

Open Caissons Used on One Pier

The conditions at the pier supporting the bascule and 98-ft. span approaching from the westerly end of the bridge required a different type of foundation. No piles were used, there being a good bearing at El. 22, consisting of loose coral limestone rock compacted with yellow clay, known as "caliche," which is typical of the river banks and surrounding country. After considerable dredging, open caissons were put down and excavation continued by divers, pumping out being impossible owing to the limited plant and extreme porosity of the material encountered. The caissons were made of 12-ft. 8-in. diameter cylinders concreted around 8-ft. cylinders to which were added the 8-ft. cylinders which formed the shafts of the pier. They were assembled complete on board a scow; wooden bulkheads closed their bottoms and enabled them to float when launched into the water. After being located and sunk into position, the bulkheads were removed by divers; and as the excavation proceeded, the caissons were further lowered by weighting down. Concrete was placed through the water with a wooden bottom-dump bucket of 15 cu. ft. capacity. After filling the base the shaft cylinder was pumped out and concreted in the dry.

All of the pier concrete is of 1:3:5 mixture. The stone was all hand broken, the coral limestone in the vicinity being quite easy to break with a small hammer. The native women at times gather up the loose rock near-by and join in the breaking at 10c. per barrel.

All of the steel spans are riveted deck trusses, designed to carry a 20-ton road roller or a uniform load of 80 lb. per sq.ft., 15% being added to the live-load stresses for impact and unit stresses allowed as per American Railway Engineering Association specifications. The floor is of native hardwood, 3 x 8 plants of

"candelon" laid with ½-in. joints on 5 x 5-in. nailing strips of "baria." All fastenings are galvanized iron.

The lift span is a Strauss trunnion bascule, the main bearings of which are supported from the pier on steel columns. The counterweight contains 40 cubic meters of concrete, reinforced to carry the load into a steel frame which is suspended on bearings from the heel end of the bascule truss. The counterweight was built in its lowest position, the bascule being erected in the open position to accommodate river traffic. To avoid placing the floor while the bascule was in the vertical position, the counterweight was built with large temporary pockets; and when the span was lowered, the pockets were filled as the weight of the floor was added. The machinery for operating the span consists of shafting and gearing which drive a pinion engaging a rack bolted to the structural steel. The machinery is hand operated; four men on the bridge floor working a capstan can open or close the span in 10 minutes.

For the erection of the steel spans, a 3-ton Terry & Tench "jinniwink" derrick was used. The steel, except the bascule, was erected on falsework, and the derrick was moved out over the stringers as the erection proceeded. The same rig without the A-frame was used as a gin pole to erect the bascule in the open position. The floating equipment for building the foundations was all in one unit—a scow 30 x 50 ft., on which were mounted the boiler and derrick engine. The 58-ft. boom cleared the top of the piledriving leads mounted on the front end of the scow. A concrete mixer was put on board when concreting piers, the derrick handling the concrete with a bucket holding 9 cubic feet.

The bridge was built under the direction of A. J. Collett, Director General of Public Works for the Dominican Government. The Strauss Bascule Bridge Co., of Chicago, was the consulting engineer on the design of the superstructure. The general contractor was Sr. Jose Turull, of Santo Domingo. The superstructure was furnished and erected by C. D. Ridgway, Jr., of the Leonard Construction Co. The steel was fabricated at the Belmont Iron Works, Philadelphia, and the machinery by the Earle Gear and Machinery Co. The writer was engineer in charge during the period of construction.

Finding and Stopping Pollution of Austin Water-Supply

Surface Drainage and Lack of Sewers Are Charged with Infection of Filter Gallery—General Clean-Up Made

BY JULIAN MONTGOMERY
Lately City Sanitary Engineer, Austin, Tex.

THE necessity for careful supervision of the quality of a city's water-supply is shown by recent experiences at Austin, Tex., where it was found that water from filter galleries was being polluted by several unsanitary conditions. These are now being remedied, and hereafter it is expected that close watch of the character of the supply will be kept with the aid of a laboratory.

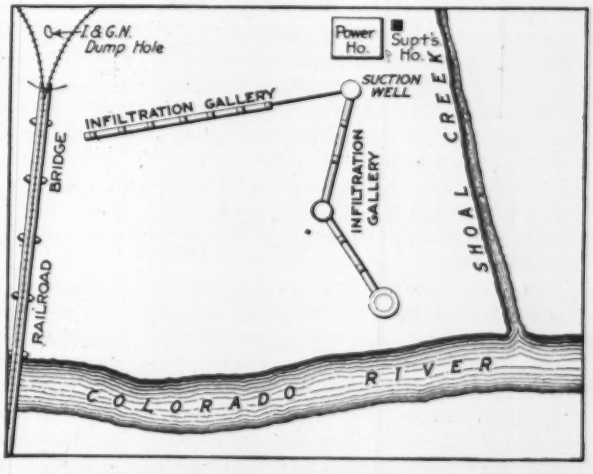
Since 1911, the water-supply of Austin, Tex., has been collected by reinforced-concrete infiltration galleries placed along the north beach of the Colorado River about 15 ft. below the low-water stage of the river. Two pumping stations are maintained. The main station is supplied by two galleries. One gallery is nearly parallel to the river; the other is at right angles with the river and connects two concrete wells somewhat deeper than the galleries. Both galleries drain into a suction well, as shown by the accompanying plan. The auxiliary pumping station is located farther up the river. This station is supplied by one infiltration gallery, at right angles with the river bed, and is operated only when the supply at the main station is inadequate.

The whole State of Texas suffered from dry weather in 1916. During the latter part of August of that year, the continued drought became so severe that rice growers below Austin obtained permission to drain the lake impounded by the Austin dam. Shortly afterward a large number of dead fish were noticed in the water below the dam. This was considered so significant of the impurity of the water that steps were taken immediately to examine the city water to determine whether it was contaminated to any extent whatever. The first tests, made by the State Board of Health and Food and Drug Department, gave such adverse results that further tests were made to confirm them. All tests showed the water from the filter galleries to be contaminated.

INVESTIGATION OF SOURCES OF CONTAMINATION

Following this interpretation of the analyses, steps were taken at once to determine the source, or sources, of contamination and to supply an immediate and effective remedy. It was realized that because of the different locations of the two pumping stations there could be separate sources of contamination of the water supplied by each station.

The investigation included the digging of test holes along the sand beach and the getting of samples of the material and water; the making of chemical tests to determine if the river water entered the galleries directly through cracks in the lower concrete well, or



LOCATION OF FILTER GALLERIES, AUSTIN, TEXAS

otherwise; examination of the stagnant pools along the beach; examination of dry closets and cesspools in adjacent territory, and examination of the dumping grounds of the International & Great Northern R.R.

It was found that at low stages the raw river water is fairly good. The large storage reservoir furnished by the Austin dam is directly responsible for this. It is during high stages of the river, and especially when the lake is drained, that contamination is most likely.

Surface Drainage Pollution

At the main station, after a study of the data acquired from all the investigations, it was concluded that the principal source of contamination was the surface drainage from the dumping ground of the International & Great Northern R.R. and the few houses on the near side of Shoal Creek. This dumping ground lies between the two railroad embankments forming the north approach to the railroad bridge. A small pond of water is usually present. This pond is practically always covered with a thick heavy oil which is drained from the cars. Pullmans are often stationed on either side of this pond and much waste water enters the pond from that source. Stockyards also drain into it.

Ordinarily it would seem that the oil which had drained into the pond would possess considerable sterilizing value. Investigation proved this not to be true. Tests made at various times showed as many as 228,000 bacteria per c.c., of which 17,000 were acid-forming and 1000 gas-forming bacteria.

Pond Located Above Filter Galleries

This pond is situated at an elevation considerably above the filter galleries, and water from this point very easily could percolate through the gravel railroad embankment to the west end of the north gallery. Several weep holes in the west end of this gallery are stained, and on different occasions water has been found entering the gallery through them when it was not entering at any other point of the same elevation.

Following a rain which occurred while the investigation was in progress, tests brought out the fact that certain organisms contained in the pond were found in the north gallery but not in the south. The groundwater level is higher in the north gallery, and probably much of the contamination in the south one is derived from it.

There are not many houses on the watershed of Shoal Creek that could be a source of contamination for the main station. At the same time many people, mostly Mexicans, are continually passing along the railroad, which is just north of the power house and parallel to the river. The territory is fairly remote from the residence district, and the few houses are scattered. Consequently a good opportunity is offered for satisfying the demands of nature.

Of the two stations, the water-supply from the auxiliary station was found to be in the worse condition. The investigations showed that the most probable source of contamination of the water-supply at this station was the surface drainage from a large, unsewered district, inhabited mostly by negroes. During light rains the surface flow comes upon the sand beach but does not reach the river. Consequently a great deal of filth and waste is deposited near the galleries.

The long intervals of rest between the short times that the auxiliary station is in use are favorable to the growth of bacteria. This could account for the worse condition of the water at that station. Another notable fact disclosed by the investigation is that rains increase the bacterial count at both stations.

Means of Preventing Pollution

At the first signs of contamination, before the final results of the preliminary investigations were available, an emergency hypochlorite plant was installed. This was kept in use until a chlorine control apparatus could be obtained. Since the installation of this apparatus, daily tests have shown the absence of B. coli from the city water.

In addition to the foregoing, the city was granted by the State Legislature a 25-year lease of the sand beach on which both plants are situated. This lease goes into effect Aug. 6 of this year and abrogates all other leases of private parties to remove gravel from the beach. The lease was obtained primarily so that the city could properly protect the water-supply. As long as gravel was allowed to be excavated and removed from the beach the filter material was impaired and water was allowed to collect in the excavated pits. The terms of the lease provide that no gravel shall be removed from the beach for commercial purposes. The consideration is $2500 per year.

It is the intention of the city to restore the beach as far as practicable to its former topography. All underbrush will be cleared off and the surface leveled by plowing. Creeks and gullies will be opened up to drain directly into the river. The beach will be policed properly to prevent the future deposit of any filth or waste.

All cesspools in the district tributary to the sand beach are to be drained, disinfected and permanently closed. For those places that cannot connect to the sewers and desire to use the plumbing fixtures installed for the cesspools, a water-tight concrete chamber will be used and the contents treated with a powerful caustic.

Cast-Iron Intercepting Sewer Proposed

Plans have been prepared for a cast-iron intercepting sanitary sewer main to extend along this beach and out through the unsewered negro district. All houses and stores will be compelled to connect to it.

Proper safeguarding of the water-supply demands that other measures be used to prevent contamination while the sewer lines are being constructed. For the places that have privies and cannot connect to the present system, it is proposed to install a bucket system. Most of the privies can be remodeled into fly-proof sanitary closets. This bucket system could be extended to care for all parts of Austin that the present sewerage system does not serve, and should be made a permanent branch of the system.

It is thought that with the above remedies, in connection with a laboratory for complete water analysis, Austin will be assured a pure water-supplpy.

The investigation was directed by Dr. W. B. Collins, state health officer; V. M. Ehlers, state sanitary engineer; Prof. R. G. Tyler, of the University of Texas; M. C. Welborn, city engineer, and the writer. The writer also made the survey for and designed the proposed intercepting sewer.

Drainage-Basin and Crop Studies Aid Water-Supply Estimates

Survey of Culture and Soil Will Lead to Estimates of Losses by Plant Interception and Transpiration and by Soil Evaporation—Most of the Evaporation Formulas Now Used Are in Error

By ROBERT E. HORTON
Consulting Hydraulic Engineer, Albany, N. Y.
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This is the last of three notable articles by the author, developing the scientific attack of the important problem of forecasting water yield for power, municipal supply or irrigation. The other two were published in "Engineering News-Record" of June 7, p. 490, and August 2, p. 211. In the present article is described a new kind of survey to be made, and the use of the data thus derived.—Editor.

WITH this article the writer will terminate the suggestions that he started out to make in the hope of helping other engineers to secure more dependable estimates of water available for given power, domestic-supply and irrigation projects. Three phases indeed will have been touched upon, but the subjects have not been at all fully covered. Moreover, it did not seem possible, within the space that a weekly journal should allot to such a series, to give examples of computations based on the principles set forth. The sole object has remained to suggest methods and lines of study likely to lead to safer results.

Inspection of a Drainage Basin for the Purpose of Securing Data

Inspection of a drainage basin for the purpose of securing data to form the basis of judgment in estimating the low-water flow, average yield or flood discharge may be made to furnish valuable data, but it must be carried out along well-planned lines. The writer has known of an inspection being made by a number of engineers for the purpose of forming an opinion as to the low-water yield of a stream, and the principal stops were made at liquor emporiums; no notes were taken, and the resulting estimate was, as might have been expected, greatly exaggerated.

The method of inspection will depend somewhat upon the character of the data available and the results to be obtained. Where there are several railroads traversing the drainage basin, a considerable part of the inspection can often be made by local trains; preferably, two persons should work together, one sitting on each side. A better inspection may be made by automobile, traveling at a speed of not over 20 miles per hour. In making inspection by automobile, three persons are needed—one as pilot to keep track of the location of car and direct its course, one as observer, and one as recorder. In a basin 40 miles wide by 80 miles long, a traverse of four roads longitudinally and an equal number transversely will usually give good results. Such an inspection of seemingly similar basins will often reveal surprising differences in culture and soil conditions.

The best available map of the area should be secured, Government topographic maps always being preferred. The inspector should have before him a map of the drainage basin on a stiff board. The inspector should also prepare beforehand a schedule containing columns having headings corresponding to the different types of crops, cultural and soil conditions that it is expected will be encountered within the basin, with a few blank columns for special conditions. For example, in a region where the principal agriculture comprises the growth of wheat or rye, and corn, oats or potatoes, in rotation with hay and pasture, there should be headings for each of these crops, together with additional column headings for stubble and permanent meadow, and fallow or new plowed ground, depending on the season of the year when inspection is being made, together with headings for forest and orchard.

Character of Culture Noted

In traversing a road or railroad, the observer notes in proper columns the character of the culture on every field that comes within his range of vision. As a rule, where crops are produced in rotation, the average size of fields will be about the same. If there is marked difference in the size of fields, as, for example, in the case of orchards, this should be noted, and an estimate of the relative sizes of fields should be made. In this way a very large number of fields can be listed in a single day, and experience in comparison with Government agricultural statistics shows that a reasonably accurate estimate of the cultural conditions can thus be arrived at.

If there are marked variations in soil, and the valuable soil maps of the United States Department of Agriculture are not available, the regions covered by the principal different types of soil should be outlined on the map as they are encountered. Similarly, marked variations in the surface hard rocks may be of importance, as, for example, where a region changes from shale to limestone. Often these data can be obtained directly from existing geologic maps. It is often possible to judge from the topography and from road and railroad cuts the depth below surface at which the rock lies. These facts should also be noted.

Groundwater Measured

In view of the great importance of groundwater in relation to low-water flow and the general regimen of streams, it is always desirable that an inspection be made by some methods such that stops may be made from time to time, in regions where there are surface wells, to determine the depth of the groundwater. In-

quiries should also be made as to the amount of fluctution in groundwater level. In a dug well, the depth to groundwater can be readily measured with a metallic tape, chalked near the lower end.

As to forests, if extensive, their location and approximate boundaries should be marked on the map as far as they can be observed. If there are merely isolated patches of woodland in a region generally clear, they may be noted in a separate column the same as fields; but it is necessary to estimate the average size of the patches.

With a pair of prismatic binoculars the culture on an area of several square miles may often be inspected and tabulated from a single well-chosen viewpoint. For the purpose served by such a field inspection of a drainage basin, there is in general little hydrologic difference in effect between forests of different types or between forests and dense brush land. It is well, however, to make general notes as to the character of the wooded areas, whether deciduous or coniferous trees or brush, and whether dense or sparse. Liberal use of abbreviations will facilitate rapid note-taking.

Boundaries and Lakes

The agreement between the actual position of the watershed line or boundary of the drainage basin and its location on the map should be noted and any errors corrected. This is especially important in the case of small drainage basins where errors occasionally occur, even in the Government topographic maps, which may be of great relative importance.

If there are large lakes or marshes, at least an approximate cross-section of the outlet of each should be obtained and, in general, a measurement made of the discharge, and data obtained as to the range of natural fluctuation in water level. Such data will form a basis for estimating the supply to the stream from natural storage.

Stream-channel storage is also of importance, both in relation to flood discharge and low-water flow. From good maps the length of the stream channels can be approximately estimated. In the course of the inspection the average width and depth of the stream channels between banks should be approximately estimated and noted. This will form a basis of estimating the total supply to the stream from channel storage for a given change in water level.

Evidences of any important watershed leakage should be noted, especially on small drainage basins. If the underground and surficial divides do not coincide, estimates of yield based on surface conditions alone may be grossly in error. The absence or existence of artesian wells and springs, the dip of sedimentary rocks and the depth of extensive drift deposits, especially near the watershed lines, are of importance in this connection.

Importance of Cultural Conditions

Hitherto in estimating run-off in the absence of gagings, the only physiographic, meteorologic or cultural factors taken into account have been precipitation, slope and temperature. Slope, as pointed out by the writer (*Trans.* Am. Soc. C. E., Vol. 79, p. 1170) is of much less importance in relation to run-off than in relation to floods. *The importance of cultural conditions has not been in general fully appreciated heretofore.*

Consider, for example, two similar areas, one covered, say, with corn, and another with wheat. For the corn area, the crop is at maximum development during July, August and September. The soil is usually loose and open, so there is little surface run-off. Probably 10 or 15% of the rainfall is ordinarily intercepted by the plants and evaporated without even reaching the ground.

The transpiration loss is very large, but owing to mulch, shading and protection from wind, direct soil evaporation is small. Wheat ground is either plowed for sowing a new crop or else is covered only with stubble and perhaps a subsequent growth of grass during the months when the corn is at its maximum development. During these months the soil in wheat stubble is hard packed or baked; surface run-off is increased; there is little infiltration, interception or transpiration, but free wind action and imperviousness of the soil facilitate soil surface evaporation. Many other examples might be cited, but it seems evident enough that the hydrologic conditions are profoundly modified by the character of culture and vegetation, especially during the critical low-water months of the summer season.

Three-Fold Division of Water Losses

This example suggests a three-fold division of water losses: (1) Interception; (2) transpiration; (3) soil surface evaporation.

Interception—Except in the writer's practice, interception seems never to have been considered as a separate item. It is not surprising that overestimates of run-off based on rainfall have been common, when this factor, which experience shows may reduce the precipitation reaching the ground by 15 to 35% has been commonly overlooked or considered only indirectly. There are numerous data available on interception by trees, but more extended data are needed as to interception by growing crops.

Transpiration—There has been a common belief that transpiration is a special case of evaporation and need not or could not be separately considered in estimating water losses or run-off. Probably the maximum transpiration for a given plant is at times limited by the evaporation conditions. At other times, transpiration rate is much less. Meyer has attempted to estimate transpiration losses as a function of temperature. Correlation studies by J. Warren Smith and others show that the development of a given crop in a given year is often as much a function of rainfall and rainfall distribution as of temperature. The best indicator of water losses by transpiration generally available is probably the result of direct observation as to the state of development of the crop or the amount of dry matter developed.

A determination of the transpiration losses by this method involves three factors: (a) The area covered by a given kind of vegetation; (b) the average crop yield per acre, and (c) the transpiration depth in inches per unit or crop yield. The first data are obtained from inspection or agricultural statistics. The

second can generally be obtained from crop reports for a given date or from agricultural statistics for a given year. Data as to transportation losses in terms of crop yield are now being somewhat rapidly accumulated. Many such data are summarized in recent bulletins of the United States Department of Agriculture. This method of estimating transpiration is admittedly approximate, but has at least the merit of being founded on matters capable of direct observation.

Evaporation—A common practice among engineers has been to assume the evaporation rate from water surfaces in a drainage basin to be equal to that measured at the nearest station where an evaporation record has been kept. Extensive study of evaporation records and processes has led the writer to the conclusion that, while some of the existing records probably show the evaporation rate from broad water surfaces with approximate accuracy, yet many and probably the large majority of such records, while often correct for the conditions under which they were taken, cannot be applied either to broad water surfaces or to evaporation from moist soils.

The projection of the rim of the evaporation pan above the water surface injects a serious error into the result. The temperature of water in an evaporation pan is rarely the same as the temperature of a natural water surface or of moist soil. An area factor is involved which is not constant even for the same pan.

Most Evaporation Formulas in Error

Most existing evaporation formulas are in error in that they involve a linear factor for wind correction such that wind effect apparently increases indefinitely as the wind velocity increases. It has been proved experimentally, and is indicated by physical considerations, that since the wind can do no more than to remove the water vapor as fast as it is emitted from the liquid surface, there is a maximum or limiting value of the wind factor corresponding to each water surface temperature. Apparently, this value corresponds to a wind velocity of about 15 miles per hour.

In view of the difficulty of duplicating natural conditions in the use of atmometers, the writer is inclined to agree with Bigelow that calculation is to be preferred to evaporometer records in most cases for estimation of evaporation rate from moist soils or broad water surfaces. A formula for calculating the evaporation rate in any locality from meteorologic data generally available has already been presented in a separate paper (*Engineering News-Record*, Apr. 26, 1917) and need not be discussed here.

It seems to have been generally assumed that evaporation increases with altitude. Evaporation is controlled jointly by the temperature of the evaporating surface, the amount of vapor present in the air, and the wind velocity. In some cases barometric pressure may also be important. Temperature is the most important factor. This decreases with increased altitude. Unless the effect of decreased temperature happens to be more than offset by reduced vapor pressure and increased wind velocity, then the evaporation from natural water and land surfaces will generally decrease instead of increasing with increased altitude, although there may be a certain elevation at which the natural evaporation rate is a maximum and up to which it increases and above which it decreases. This conclusion seems to be confirmed by experiments on Mt. Whitney with similar evaporation pans exposed at different altitudes. The subject is one that requires careful study, and bald conclusions which are contrary to well-known physical facts have often been reached as to the evaporation losses from drainage basins.

The evaporation loss from the soil surface is the product of two factors—evaporation rate and evaporation opportunity. This second is a term involving the degree and duration of moisture of the soil. In general, the evaporation opportunity is less than unity, and consequently the evaporation loss from a soil area is less than that from free water surface subject to the same conditions of evaporation rate.

Assuming that the evaporation rate throughout a given season has been determined by calculation, the evaporation opportunity may also be approximately estimated from the consideration of the character of culture and from the frequency and average interval of occurrence of storms. During rain, the evaporation opportunity for soils is unity. After rain has ceased, it decreases rapidly, approximately in accordance with the inverse exponential law, often rapidly approaching a constant minimum so that the evaporation opportunity remains small and nearly constant during most of the interval between rains.

Many data regarding evaporation from soil surfaces are now available, and a fairly close estimate by judgment based on such data may often be made without calculations.

Winter Run-off

In winter when the ground is blanketed with snow, the water loss conditions are much simplified. Transpiration is eliminated, evaporation opportunity is unity, and the range of temperature of the evaporating surface is more nearly constant. The run-off is, however, complicated by snow storage to such an extent as to make full treatment here impracticable. Temperature is a controlling factor, and the run-off time unit becomes then the interval between successive thaws. Not only is there no direct relation between precipitation and run-off in the same time unit, but the uncertainties of precipitation records are greatly increased.

Many gaging records show winter run-off in excess of the measured precipitation. This is probably due in part to deficiencies in the catch of rain gages when used to measure snowfall. However, especially in earlier records of stream flow and to a considerable extent at the present time, there is a tendency toward errors in excess of the true values. Sometimes there is a continuous supply to streams from previously stored groundwater with but little replenishment of the groundwater storage during winter months. This also tends to increase the measured run-off relative to the amount of measured precipitation. Snow surveys for the purpose of determining the water equivalent of accumulated snow storage just before spring thaws set in afford the most reliable basis of estimating the available water-supply from winter precipitation.

This discussion thus far has related to the determination of precipitation and water losses. The difference between these factors for any time period does not represent the actual yield of a drainage basin, but only

represents the precipitation which remains available to supply the streams after losses are deducted. The actual yield is this quantity as modified by groundwater storage and supply to the stream.

An ingenious method of correcting the available supply for groundwater and surface storage has been devised by Vermeule and improved by Parker. In applying this method, it is assumed that the curve of relation between groundwater stage and the supply to the stream conforms to some one of three given types, and the method rests further on the assumption that there is a certain maximum and minimum groundwater storage which is approximately constant for all basins of the same type. If actual and accurate gagings of a stream are available for a period of, say, 10 to 20 days during which time no rain has fallen, then a groundwater supply constant can be calculated for the drainage basin and a curve of groundwater supply can be constructed for the basin in question. Thus the necessity of assuming a groundwater curve is eliminated.

The estimation of the minimum yield of a drainage basin in the absence of actual gagings is a difficult matter. It generally involves the problem of finding what the stream yield would be from natural storage alone during the longest period of no rainfall ever likely to occur during the months of maximum water losses.

Even long-continued gagings may not show directly what the yield of a stream would be during a rainless period of, say, 30 or 50 days, unless such a drought period happens to have actually occurred while the gagings were in progress. To attempt an estimate of the minimum flow of a stream—in other words, its flow during periods of no rainfall—by basing such an estimate on rainfall as the only factor is the height of absurdity. Where minimum flow is to be determined, accurate gagings should always be made if possible covering a period of 10 to 20 days without rainfall.

With gagings such as described, the time relation between groundwater supply and duration of drought can be established, and the rate of supply to the stream from groundwater alone after a period of drought having any chosen duration can be estimated with considerable accuracy. It is not necessary that the gagings should be taken during a low-water period; they answer nearly as well if taken when groundwater and other storage is filled, provided there is no coincident rain.

Many engineers have considered short or fragmentary gagings as of little value, but used as above described they may become of great value. This is the only method known to the writer by which even an approximately correct estimate of the low-water flow of a stream can be arrived at in the absence of long-continued gagings of the same or a similar adjacent stream.

Road Maintenance Important in Maine

Particular stress is being laid on maintenance work this year in the State of Maine. The State Highway Commission has employed about 400 patrolmen to look after 3300 or 3400 miles of roads. Of this total, about 1500 miles is improved state or state-aid highway, while the rest is unimproved roads. All the road under patrol, however, is main thoroughfare or principal market road. Paul D. Sargent, chief engineer, is in charge.

Freezing Ground Acts Like Hydraulic Jack

Heaving and Settling Back of Piers of Railroad Bridge Over City Street Lead to Interesting Deduction

By H. J. Gilkey
Chicago

Some 16-ton concrete piers which were heaved this past winter by as much as 3 in. and subsequently settled back to their original elevation came under the writer's observation. This most unusual and extreme condition cannot be explained by ordinary frost action, but can be accounted for by the piers becoming the pistons of hydraulic jacks in which frost produced the moving pressure.

This occurred in an important Middle-West city at a street ("A") where a bridge was being built by one

FIG. 1. INDIRECT FROST ACTION HEAVED PIERS AS MUCH AS 3 INCHES

of the large trunk lines in the course of track-elevation work. Some heaving also occurred at an adjacent street, "B." The abutments and piers at both streets were poured during the summer and autumn of 1916. The bridge steel could not be placed until the following season, hence the piers and abutments carried no load other than their own dead weight.

Moderate Foundation Loads but Poor Drainage

At "A" street the side piers weigh 31,000 lb., which includes the steel I-beam grillage embedded in them for the column base to rest upon. The center piers weigh 36,000 lb. each. The side piers are 8 ft. square on the bottom, and the center piers 8½ ft. square. They rest upon solid blue-clay strata, and the unit load of both center and side piers on the foundation is about 500 lb. per sq.ft. The abutments are at the same bottom elevation as the side piers, which is 9 in. higher than the bottom of the center piers. The unit weight of the abutments is 1630 lb. per sq.ft. There was no heaving or settling of the abutments.

At this street, where the most heaving occurred, only the center and south rows of piers were appreciably affected. The north side of the street was fairly well drained and much drier than the south side; all conditions were favorable to waterlogging on the south side of the street. The street itself has a depression of

6 ft. to the subgrade of the pavement and so makes a natural hollow for the collection of water. In November, 1916, an 8-in. water main was lowered on the south side of the street. The backfill was thoroughly flooded to prevent future settlement. Cold weather set in and there was no opportunity for drying out. Drainage to the sewer was very slight.

The bottom of the north side piers was about 4½ ft. below the ground surface, of the center piers 4 ft., and of the south piers 3½ ft.

Piers Found Heaved in Early Spring

The grillages (embedded in the concrete) were all set with extreme care and were checked and re-checked for elevation. From the latter part of November, 1916, no further levels were taken until Mar. 15, 1917. The discovery was then made that the south row of piers had heaved by amounts varying from 0.07 to 0.22 ft., or 2¾ in. The center row showed heaving ranging from 0.01 to 0.09 ft., or 1⅛ in. The north row showed nothing in excess of ¼ to ⅜ in., most of which could have been in the original setting.

After this was discovered, levels were taken at the four corners and center of each grillage plate at intervals of 3 to 5 days. As the ground thawed the piers settled back into position until the highest corner of any grillage was but 0.06 ft., or ¾-in. above what it should be. A settlement of as much as 0.18 ft. or 2⅛ in. is shown.

Probably no Expansion of Freezing Ground Under Footings

The question, of course, arises as to how this action took place. It seems safe to assume that freezing was the cause. The usual explanation is that the frost simply penetrated to a level below the bottom of the piers and heaved them by direct action, but this does not seem adequate for the following reasons:

(1) It is very doubtful if the frost penetrated as low as the bottom of the piers. Notwithstanding the unusually severe winter, it is probable that the adjoining abutments were more or less of a protection.

(2) If the frost did penetrate to below the bottom of the piers there could not have been more than from 6 in. to 1 ft. of frost at the most. This thickness of frost could not possibly heave a pier nearly 3 in. Water expands about $\frac{1}{10}$ of its volume upon freezing. The expansion of water-soaked soil would not be greatly in excess of this if as much. That would mean but 0.1 ft. upheaval for a whole foot of frost under the pier.

The writer is rather inclined to attribute the rising to action similar to that of an hydraulic jack. The pier would be analogous to the piston of the jack and the water or semi-fluid mud is forced under the pier by the pressure from the freezing expanding strata nearer the surface. The accompanying sketch will illustrate.

Let *AB* represent the surface of the ground. Suppose the ground to freeze to a depth *d*, such that the frozen layer becomes rigid and unyielding. Let the frost then penetrate to an additional depth *e*. The layer *e* expands in freezing. It exerts a pressure both upward and downward. The frozen mass *d* is unyielding and if the weight of the pier is less than the force required to break the rigid layer, the water and semi-fluid clay will be forced upward like a piston. Such an action would account for any amount of heaving.

The experience at "B" street certainly disproves the theory of direct frost action under the pier and seems to agree well with the explanation offered.

At this street, where there is practically no depression, only 3 or 4 piers out of a total of 42 (14 in a row) were found to have been raised. These varied from ¾ in. to 1¼ in., only one pier having been heaved the latter amount. But at this street the bottom of no pier was less than 5½ ft. below the ground surface. It is certain that no frost penetrated to that depth. So far as the writer can see, the preceding explanation is the only possible one that could cover the "B" street situation.

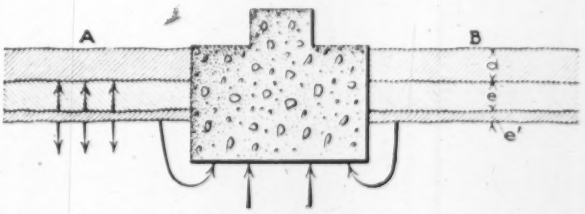


FIG. 2. PIERS WERE PLUNGERS IN A BIG NATURAL JACK

It is unfortunate that test borings for depth of frost penetration were not made at both streets in order that more exact information might be had on this point.

In concluding it might be well to add that the pouring of piers and leaving them to remain unloaded for one or more seasons has not been unusual in this work. Neither have any of the conditions such as the depression and water-soaked condition of the subway differed from those in several that have been previously constructed. In many instances the piers were built for several years before the bridge steel was erected upon them. But in no case has any upheaval such as the preceding been discovered.

This might be due to one of two causes: (1) The steel was usually placed in the spring or summer season and the piers might have heaved and settled again without being detected, or (2) the unusual severity of the past winter may have caused the disturbance. Several of the engineers in charge of other track elevation work in the locality were consulted when the discovery was first made and none of them reported anything like this in his experience.

However, the chief engineer of one of the street railway companies recently stated that nearly all the track-elevation bridges in the locality raised in the winter and lowered in the summer and that the street cars had as much as 2 or 3 in. of extra clearance during the winter months.

Side-Hill Fill Held in Place by Existing Trees

In the construction of one of the roads in the northern part of New York State the side-hill fill has to be made over a wooded area. The usual procedure in such cases is to cut off the timber, leaving the ground clear before beginning to make the fill. In this case it has been decided to leave the trees standing on the supposition that by so doing the fill will be less apt to slip. The only clearing of trees which will be allowed will be in the space included between shoulder lines.

Structural Shop Has Well-Planned Framing and Layout

Four-Year-Old Company Increases Warehouse and Adds 2500-Ton-a-Month Fabricating Shop Where Special Attention Is Paid to Routing and Lighting

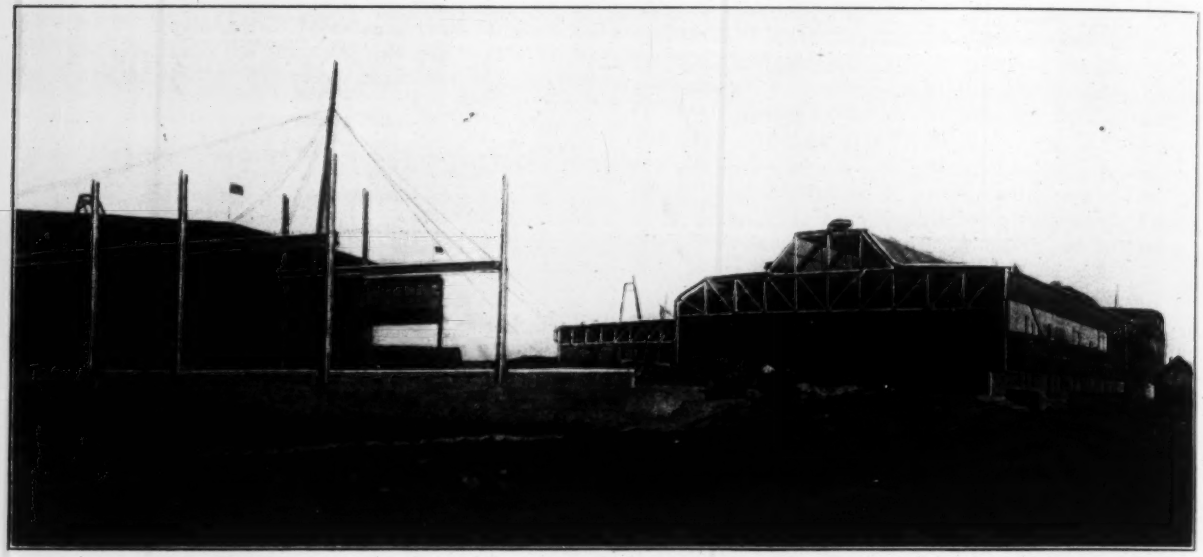


FIG. 1. FABRICATING SHOP, 130 x 500 FEET IN PLAN, IS ADDED TO STEEL COMPANY'S PLANT AT BUFFALO

THE FERGUSON Steel & Iron Co., of Buffalo, N. Y., has a short but crowded history. It was founded in 1913 mainly as a warehouse business, furnishing stock material and simple fabrications in and around the city of Buffalo. The first structure was a steel building 165 ft. wide and 100 ft. long. The next year it was doubled in length, and in the two succeeding years the additions shown in the accompanying drawing were successively made, until at the beginning of the present year the main shop and warehouse was a building 600 x 165 ft. with numerous adjoining offices and a large-material yard occupying about 5 acres.

While the warehousing business had meanwhile grown the structural fabricating plant had developed beyond expectation. Special attention was paid to small structural jobs and immediate delivery both of these jobs and of stock when required. Increase of business in the present year required a further extension of the plant and this extension was so large it was thought best to entirely rearrange the layout. When started in 1913 the output of the works was about 30 tons per month. The new plant will have a capacity of 2500 tons per month of fabricated material, and about 2000 tons per month of warehouse material. The total area of the present site is about 25 acres.

One of the drawings shows the new plant layout and the relation of the new to the old plant as developed. An entirely new fabricating shop, 130 ft. wide and 500 ft. long, is being added at one end at right angles to the old building, and an extension of 160 ft. is being made to square the old building into the new. The entire old building is to be used for warehouse storage, the addition to the new building in the corner for the temporary storage of warehouse material cut to length en route to the fabricating shop, and the new building entirely as a fabricating shop. In the warehouse will be stored in proper distribution all of small structural shapes and reinforcing material. In the storage yard, north of the warehouse, the large structural shapes will continue to be stored. The entrance to the whole works is from a siding of the nearby New York Central R.R., which siding parallels the new shop, passes by the storage area, and into the warehouse.

The addition to the old warehouse is similar in design to that building. That is, it has a center 83-ft. truss span with two side trusses 41 ft. each, forming continuous roof slopes from a center ridge. The walls have an upper and lower row of glass in steel sashes, with intermediate iron siding. The shop floor is controlled from a longitudinal traveling crane running on girder tracks framed to the middle columns.

Fabricating Shop Has New Type of Frame

The new shop is of a different type developed by the engineers of the Ferguson company, to provide a maximum of light with a minimum of weight. The central section, 90 x 500 ft., is adjoined by a lean-to 40 x 500 ft. on one side and is in the near future to be adjoined on the other side by a 60-ft. wide section to be used as a girder shop. For the thirteen 20-ft. bays nearest

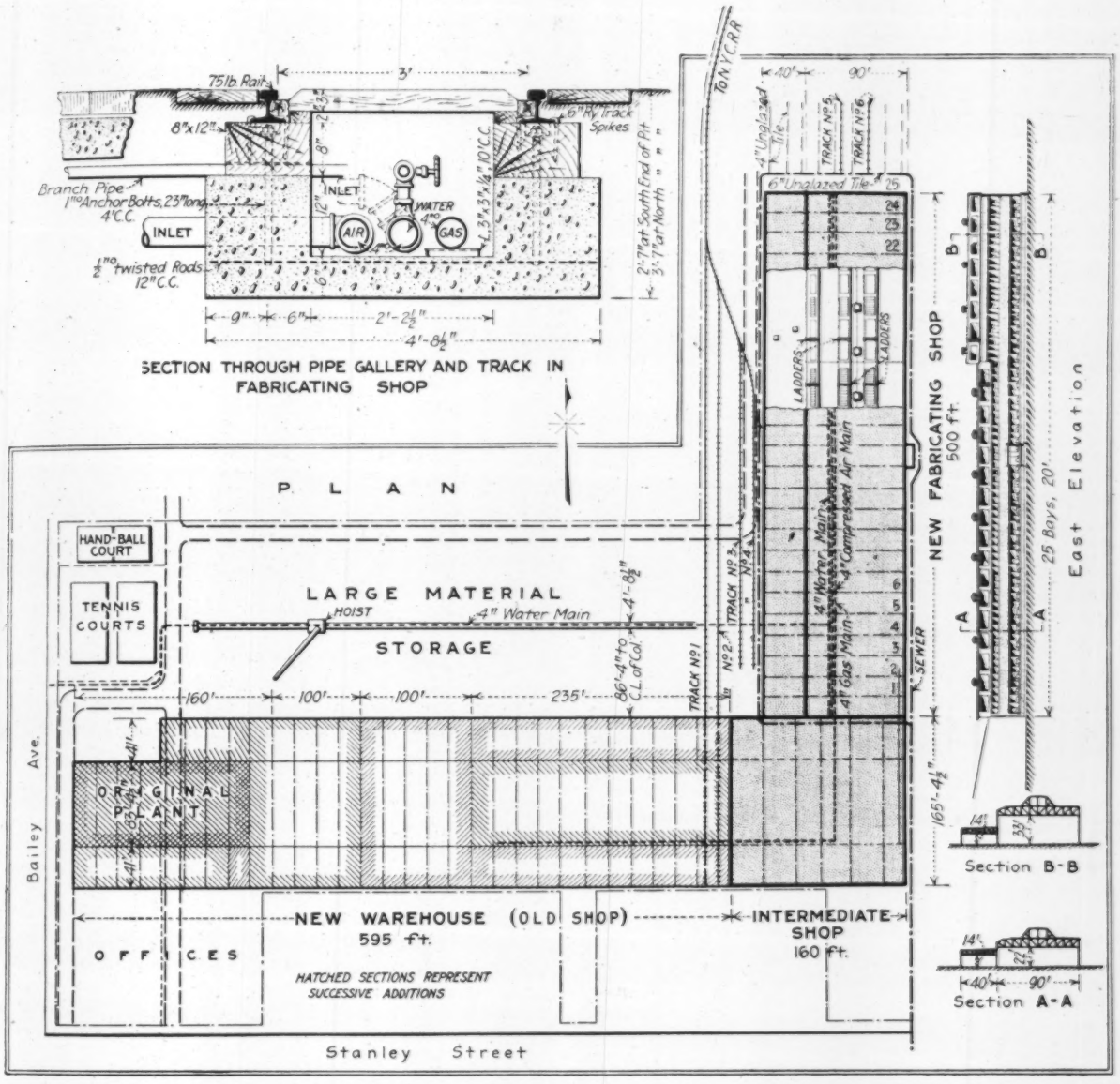


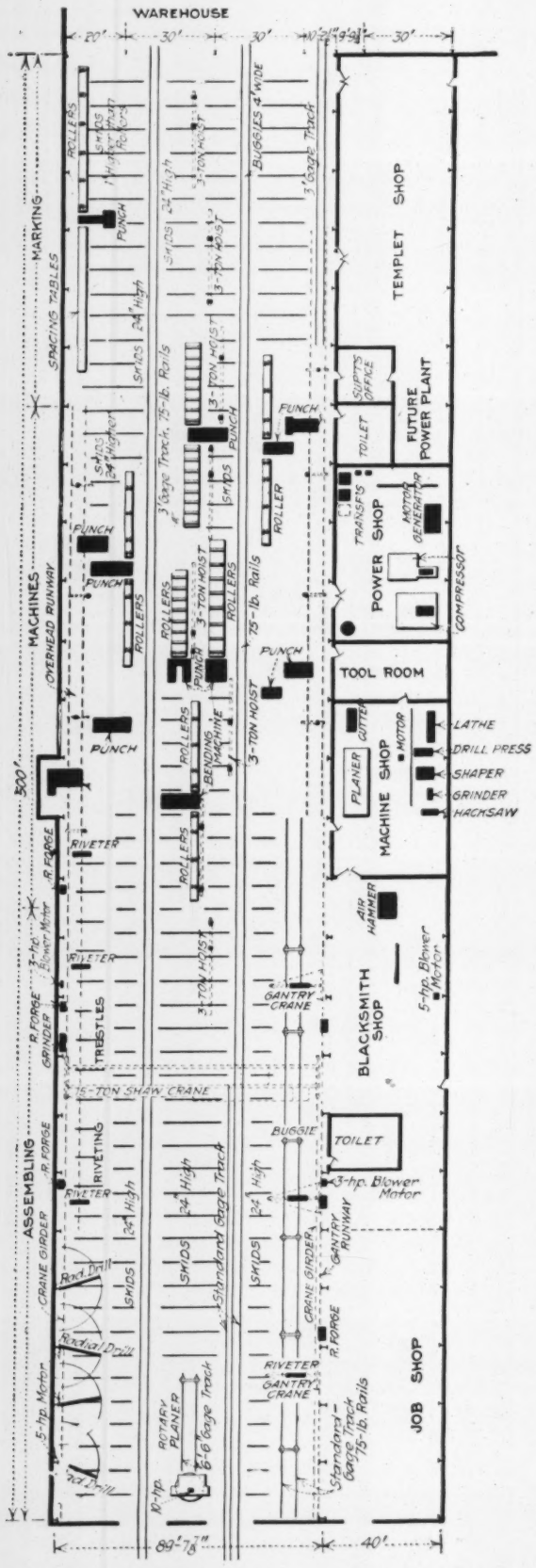
FIG. 2. HOW THE FERGUSON STEEL AND IRON CO. HAS GROWN IN THE PAST FOUR YEARS

the warehouse, which is the piece fabrication section of the shop, the main roof is carried, with a clearance of 22 ft., on a truss simple in layout except for the extreme slope at the lean-to end and the 11 ft. monitor over the central four panels. The sloping sides of the monitor and of the main truss are provided with glass. The lean-to roof is carried on a simple truss with gradually sloping upper chord. The far eight 20-ft. bays of the main shop are spanned by a similar type of truss, but the clearance is 33 ft. and this section of the shop is to be used for assembling material.

On the east side of the building provision is made, by the construction of column footings, for the future erection of the girder shop. For this shop the column footings have been already built large enough, but the columns themselves will be additional members probably fastened to the existing columns.

The type of roof truss building designed proved to be quite economical and from 10 to 15% lighter for the same capacity than the ordinary high-and-low-bay type used for fabricating shops. The new design runs about 20 lb. per sq.ft. of floor area. In addition, it gives a high degree of illumination, at a cost not much higher than the old type of small window and steel siding. At present prices glass in steel sash costs about 50c. per sq.ft. and the 2-in. concrete wall about 35c. Old type corrugated siding used to run about 9c. but now is nearer 30c. and wood sash cost just the same as steel.

The side-walls are of upper and lower steel sashes with glass, the sash being of the Lightwell type, made by the Lightwell Steel Sash Co. A pedestal wall connects the column footings and an intermediate wall space between the sash is of 2-in. concrete plastered on wire mesh. A similar wall closes the opening be-



HOW TOOLS ARE LAID OUT IN THE NEW FERGUSON STEEL AND IRON CO.'S SHOP

tween the high and low roof. The roof of both the monitor and the main truss is the Carey five-ply roofing type, while the lights in the sloping sides of the monitor and the truss are of glass framed into steel shapes designed and fabricated by the Ferguson company.

Transverse Cranes are a Feature

A feature of the fabricating shop is the crane equipment. The first twelve bays from the warehouse and of the low section of the shop are controlled by transverse 3-ton cranes traveling longitudinally on girders which themselves travel transversely on the lower chords of the roof trussing. These cranes are in every other bay and their traveling girders overhang far enough into each intermediate bay so as to completely cover the shop floor. The detail of the crane and its method of travel are shown in the drawings. This crane can pick up any of the smaller material in the fabricating areas on either side of the central track, where it is skidded or rolled down the shop toward the assembly end.

For the four bays beyond this there are two transverse cranes of the same type but of 5-ton capacity which carry material to the first assembly bay where control is had by a 15-ton longitudinal crane traveling on girders framed to the high columns of the building.

Additional crane service is had by cantilever cranes on both sides of the shop, which cranes control the various punches and riveters which line the side, and besides these there are to be numerous hook cranes which can be fastened to any part of the structure. These particularly are used in the various shops. Finally, there is to be a gantry crane outside the far end of the assembly shop to handle material to cars or storage. All hoists and cranes have electric control, the 15-ton cranes from a cage, the others from the ground.

All the cranes use direct current and all of the machines alternating current. The former is generated in the company's own power house, the latter purchased from a local company. By using direct current, better crane service is expected and at the same time an earlier completion of the shop was assured because it was found impossible to purchase a.c. 25 cycle motors for delivery at an early date.

In addition to the crane control, two main line standard-gage tracks enter the far end of the shop and extend through the assembly floor. Gantleted with these are narrow-gage tracks which run clear through into the warehouse. These tracks run on concrete walls forming the pipe trenches where all the heating and air pipes are placed. An additional narrow-gage track runs alongside the lean-to wall into the warehouse.

Structural Framing is Simple

The structural framing of the shop building is quite simple. The low columns are of outstanding angles with a 15-in. web and the high columns of the same type with an additional flange channel under the crane girder. The truss itself is of double angles. All of the steelwork was designed to carry the various hoists and cranes as laid out but in addition the columns were made extra strong to take care of loading from hook hoists which may be attached at any place. There are

about 625 tons of steel in the shop and 275 tons in the new corner to the warehouse.

Tool disposition in the shop is shown in a drawing. The layout has been carefully made so as to facilitate movement through the plant. Thus warehouse material—which incidentally is bought and paid for by the fabricating shop just as though it were an outside purchaser—is sawed to length there and moved into the common corner section. From there it is moved, by crane or hoist, to the rollers or tracks on either side of the shop and punched. Pending further movement it is stored in the central space between the narrow-

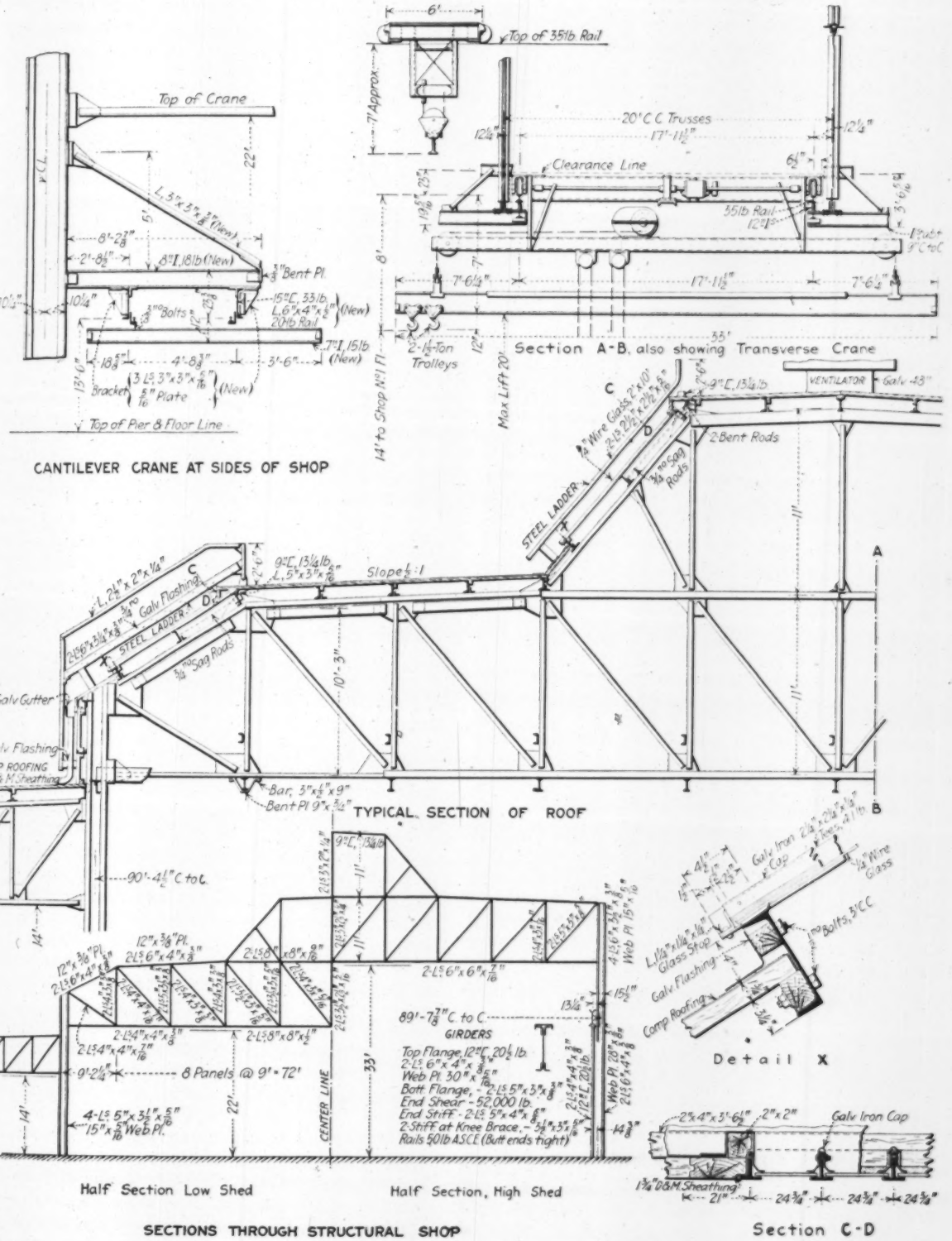


FIG. 3. DETAILS OF THE FRAMING OF THE FABRICATING SHOP

gage trucks. When required it is skidded through or by the jaw punch, in the middle section, to the angle shear or bending machine also in the center section or to the riveters on either side. The central space is then again used for storage until the 15-ton longitudinal crane picks the pieces up for assembly in the far end of the shop, where are also located the radial drills and the planer.

Separate Shops in the Lean-To

In the lean-to are located, successively from the warehouse end, the templet shop, the power house (although for the present power is purchased) the power shop, the tool room, the machine shop, the blacksmith shop and the job shop. This latter is an important feature of the plant, turning out small local jobs for quick delivery at relatively high tonnage price. The templet room floor is matched maple flooring running diagonally so as not to permit the cracks to coincide with the markings when pieces are laid out parellel with the walls. In the future, when wood paving blocks are somewhat cheaper in price it is hoped to pave the entire shop floor with such blocks. For the present a packed earth floor will be used.

The shop floor is remarkably well-lighted from the roof and outside walls. Partitions between main shop and lean-to are also largely of glass in steel-frame thus permitting the outside illumination from that side also. It is expected that the shop will be heated by hot-air blasts opening at or near each machine.

The Ferguson Steel & Iron Co. was founded by James E. Ferguson, who is President of the company. The new plant was designed and built under his direction and under the supervision of Thomas Leach, Chief Engineer of the company. The contractor for all of the work except the structural steel and its erection, which was done by the Ferguson Co., is John W. Cowper Co., of Buffalo.

War Orders Divert Freight from Railroads to Highways

Connecticut Legislature Appropriates Fund of $6,500,000 To Be Spent on State Roads During Next Two Years

ENORMOUS increases in the shipment of freight by motor truck instead of rail, owing to car shortage and railway embargoes on various classes of materials, are subjecting the state roads of Connecticut to such extraordinary wear and tear that the state legislature has provided funds to the amount of $6,500,000 to be expended on roads during the two years commencing October, 1917. All this money is to be raised by taxation, none by bond issues. Except for a million dollars, which is to be spent for certain bridges and in eliminating dangerous grade crossings, this fund will be used for the construction and maintenance of roads and at the discretion of the Highway Commission. There are no strings tied to its expenditure.

Big Shipments from Munitions Plants

The policy of building durable pavements on trunk line roads will be continued. The wisdom of this policy has already been demonstrated, for the state's roads have felt the effects of the great munition plants at Bridgeport, Waterbury, New Haven and Hartford, which have furnished more transportation business than the existing railway facilities can handle. Business of all kinds has had to resort to motor trucks. Intrastate freight shipment by this means has increased by leaps and bounds. In the first six months of this year more than twice as many commercial vehicles have been licensed as were licensed during the whole of 1915, and one-third more than were licensed during the whole of last year.

New Motor-Truck Regulations

The regulation of this enormous motor-truck traffic and the part of the burden of road maintenance it must bear is fixed by a law recently enacted. Registration fees are based on capacity and vary from $15 for 1-ton vehicles to $200 for 8 tons. Speeds must be limited to 15 miles per hour. All trucks must have rubber tires and be marked with their carrying capacity.

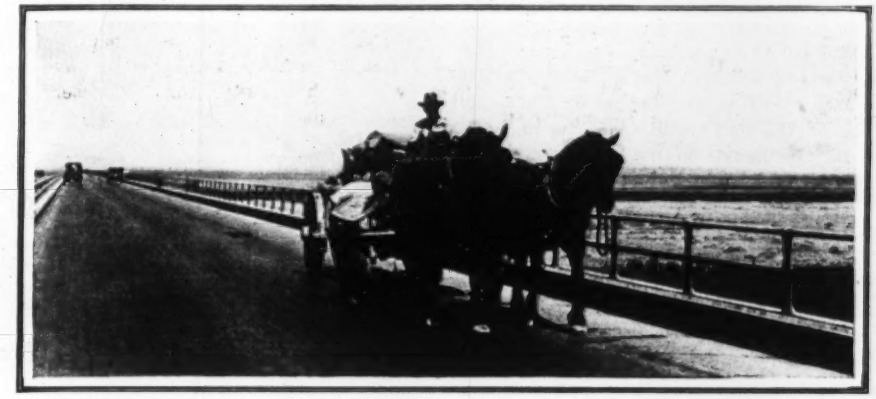
Commissioner Bennett's Views

In the face of these evidences of the increasing commercial importance of the roads, State Highway Commissioner Charles J. Bennett, in an interview with a representative of *Engineering News-Record*, said: "There can be no let-up of either construction or maintenance. The building of concrete, asphaltic concrete and other long-lived types of pavements will continue. In one town near Hartford we have under construction a mile of sheet asphalt on a 5-in. concrete base, because the intensity of motor-truck traffic demanded a durable city-street pavement and the availability of a Hartford contractor's sheet-asphalt experience and construction plant made this type the most suitable and economical.

"Construction difficulties," Commissioner Bennett continued, "are many. Structural steel for bridges is practically unobtainable, but this condition is being met by a more extensive use of the concrete arch bridge, both plain and reinforced. A bridge of this type which has been started at Derby will cost a quarter of a million dollars. The price of concrete has increased during the past few months to 30% above any previous price. Labor, however, is more easily obtained than a year ago. Since the additions to the munition plants have been completed, unskilled construction labor is not so much in demand. The price of labor, however, is unprecedented—from $2.50 to $3 a day, to be paid rain or shine."

At the present time there are about thirty contracts for road construction in force in Connecticut aggregating about $750,000; for bridge construction, about $500,000; for grade-crossing elimination work, $86,000.

There is one disappointing feature in Connecticut's road-construction program. In spite of the fact that the engineers of the Highway Commission are given large sums to spend on their work, the legislators at Hartford failed to make any provision for increased salaries.



How the Surface of a Road Affects Tractive Effort

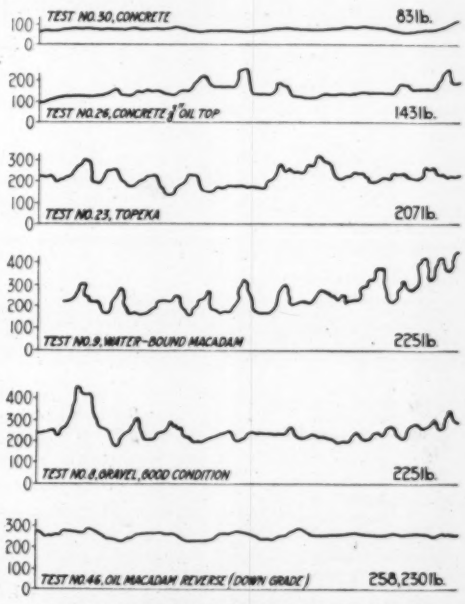
Unsurfaced Concrete Gives Best Results in California Tests with Steel Tired Wagon—Various Surfaces Compared by Special Tests Using a New Type of Recording Dynamometer

A SERIES of tests has just been completed in California which was planned to determine the tractive effort required to move vehicles over various types of roads. The results are to be used in an educational movement calculated to enlist the aid of the farmer, particularly in the good-roads movement. Tests of a similar character which were previously made, notably by the U. S. Office of Public Roads and Rural Engineering, afforded no data suited to California conditions or which could be used as the starting point for the further series of tests in tire wear and gasoline consumption which is contemplated. So the Good Roads Bureau of the California Automobile Association decided to carry out a series of tests, and for the series just completed secured the coöperation of the Agricultural Engineering Division of the University of California.

In planning the tests, it was decided to concentrate effort on securing constant conditions for a short length of time during which measurements could be made, rather than to make long runs and average the results. This policy was considered the best where experiments were to be made on the open highways and on several types of roads. One vehicle was therefore equipped and moved at the same speed over the various road surfaces to be compared. For this service a standard farm wagon was selected, equipped with steel axles of equal length and 38- and 46-in. wheels in front and rear, respectively, all wheels having 4-in. tires. The gross load was 3 tons, consisting of rice in sacks. The speed was kept very close to 2.4 miles per hour, and tests were run on level grades or, where slight grades were unavoidable, test runs were made in both directions and results averaged. At the time of the tests the usual sunny summer weather obtained, with maximum temperature of 105°.

The tractive effort was measured by a small dynamometer attached to the tongue of the wagon, which recorded the momentary pull at all times during the test runs and the total pull for the test period. This device, shown attached to the wagon tongue in one of the accompanying illustrations, makes its record over a measured distance, taken as 50 ft. in these tests. The measurement of distance is accomplished by unwinding a cord of definite length from a drum within the device. In a 50-ft. run an error of 6 in. in cord length, due to stretching or any other cause, would introduce an error of only 1% in the result. By careful measurement of the cord and occasional checking, it is kept to within a fraction of an inch of exact length and thus distance error is negligible.

The record of tractive effort is made by the pencil actuated by a lever attached to the strong spring compressed by the pull. The integrating device operates on the planimeter principle, but as the measuring wheel makes one revolution for each 4 in. and



DYNAMOMETER CURVES VARY MUCH

can be read to one-thousandth of a revolution, the instrument is 10 to 20 times as sensitive as the ordinary planimeter. As the integrating device shows in different form the same result as that traced by the pencil if desired, a check of the two results may be made by taking the area of the curve with a planimeter and dividing by the length of run.

Results Favor Unsurfaced Concrete

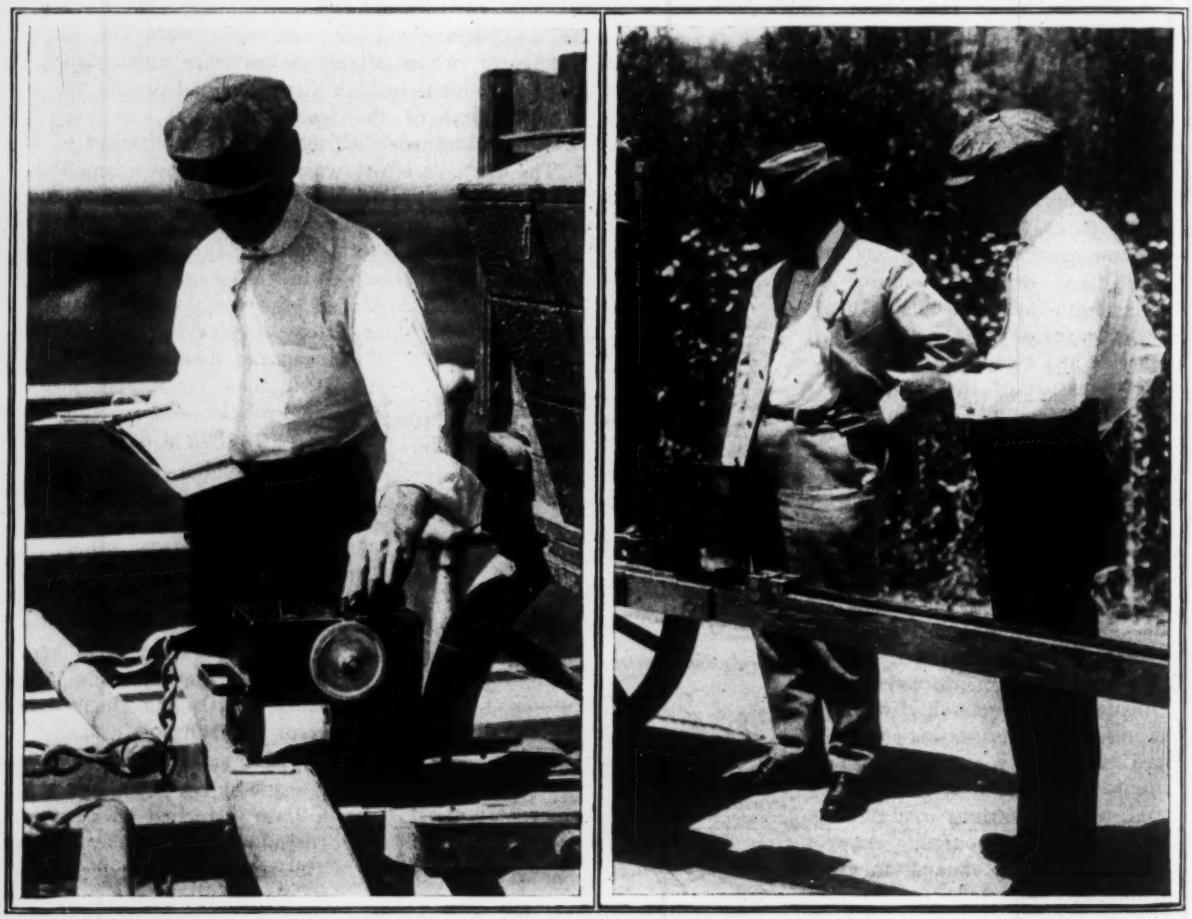
As shown by the accompanying table and curves, the resistance encountered on oiled surfaces was considerably more than on concrete. It was pointed out that this difference would be less at lower temperature, but the tests were made under normal conditions in the central California valleys, where the summer temperatures are frequently as high as 115° F. in the shade. Of course special conditions of temperature, whether higher or lower, would affect results.

It is also noted that the base supporting oiled surfaces affected the amount of tractive effort required. For example, tests 22 and 23, in which a concrete base was involved, showed less resistance than tests 18 to 20, in which the surface was on plank. The reason assigned for this difference is that the warm air gained access to the under side of the top dressing through the more or less pervious plank, as well as directly affecting the surface proper, while in the case of the concrete base, where the air had access only to the surface proper, less softening resulted. Another cause assigned as partly responsible for the increased resistance on the plank base was the yielding of the plank, which resulted in a continuous "uphill pull."

TYPICAL RESULTS FOR VARIOUS SURFACES

Test No.	Kind of Road	Condition of Road	Location	Tract. R... Total	Per ...
29-30-31	Concrete (unsurfaced)	Smooth, excellent	Near Davis	83.0	27.6
*11-12	Concrete (unsurfaced)	Smooth, excellent	Near Davis	90.0	30.0
26-27-28	Concrete (½ in. surface asphaltic oil and screenings	Smooth, excellent	Near Davis	147.6	49.2
13-14	Concrete (½ in. surface asphaltic oil and screenings)	Smooth, excellent	Near Davis	155.0	51.6
9-10	Macadam, (water-bound)	Smooth, excellent	Near Davis	193.0	64.3
22-23	Topeka on concrete	Smooth, excellent	Near Davis	205.5	68.5
8	Gravel	Compact, good condition	Near Davis	225.0	75.0
†45-48	Oil macadam	Good, new	Near Sacramento	234.5	78.2
‡46-47	Oil macadam	Good, new	Near Sacramento	244.0	81.3
33	Gravel	Packed, in good condition	Near Davis	247.0	82.3
18-19-20	Topeka on plank	Good condition, soft, wagon left marks	On Causeway near Davis	265.0	88.3
34	Earth road	Firm, 1½-in. fine loose dust	Near Davis	276.0	92.0
24-25	Topeka on plank	Good conditon, but soft	Near Davis	278.0	92.6
1-2-5	Earth road	Dust ¼ to 2 in.	Near Davis	298.0	99.3
3-4	Earth	Mud, stiff, firm underneath	Near Davis	654.0	218.0
6-7	Gravel	Loose, not packed	Near Davis	789.0	263.0

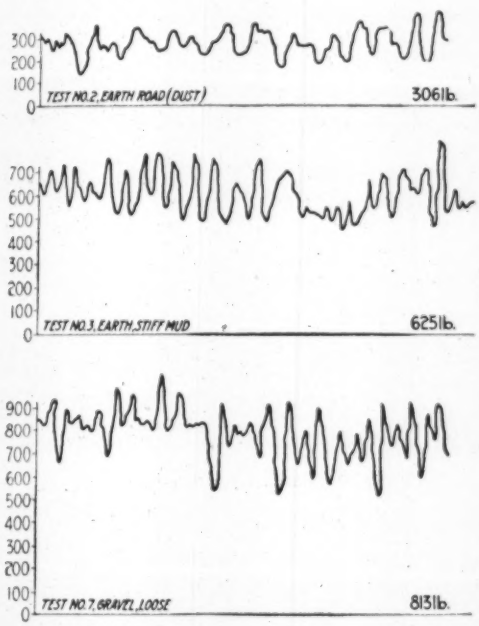
* Graphic record indicates that the load was being accelerated when test was started. † Drawn with motor truck at 2½ miles per hour. ‡ Drawn with motor truck at 5 miles per hour.



SOFT-SURFACES ADD MUCH TO REQUIRED TRACTIVE EFFORT

Record of effort is made by pencil actuated by pull on evener. Distance measured by unwinding cord of definite length

The supervision of the tests has been in the hands of Prof. J. B. Davidson, of the University of California, who is the inventor of the dynamometer. A popular-



CURVES FOR TESTS NOS. 2, 3 AND 7

ized report of the results of the tests, adapted for use in good roads propaganda, has been prepared by Ben Blow, California State Automobile Association, San Francisco.

A Traffic Average of Twenty-Eight Vehicles Per Minute

The average daily traffic on Fifth Ave., New York City, between 41st and 42nd Sts. between 8 a.m. and 6 p.m., is 16,960 vehicles—8513 vehicles northbound and 8447 vehicles southbound. Included in the total of 16,960 vehicles are 1296 motor busses, 130 per hour in both directions. The traffic averages twenty-eight vehicles a minute. At any point where this census was taken Fifth Ave. is fifty-five feet wide, which theoretically at least, permits the movement of six lines of vehicles. The count showed that passenger motor vehicles composed about two-thirds of the traffic, but these included the ponderous motor busses, which are heavier than most commercial motor cars.

The pavement carrying this enormous weight of traffic consists of sheet asphalt, 1½-in. close binder and 1½-in. top on a 6-in. concrete base. It was laid in 1913, replacing a similar pavement, which was seventeen years of age. The analysis of the top mixture used in this pavement shows a high percentage of bitumen and a correspondingly high proportion of fine material. An average of 11.7% asphalt was maintained throughout. The asphalt was of natural lake origin and carried a high per centage of portland cement filler.

While the surface is frequently broken due to the usual causes, the repairs are satisfactory and generally unobjectionable.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

The Engineer Title

Sir—When we speak of a lawyer, a preacher, a doctor or an architect, it is readily understood what vocation is referred to. Not so when an engineer is mentioned. Generally it is understood that a man who operates a steam engine is meant, one who does little more than turn on and off the steam. When the Buffalo fire-tug engine operators demanded an increase in pay and then quit, the newspapers teemed with articles headed by big scareheads: "ENGINEERS QUIT," "MARINE ENGINEERS ABANDON POSTS," "THE CASE OF THE ENGINEERS," the word ENGINEER being given unusual prominence.

If the word "engineering" is worth perpetuating, then persons practicing it should be called engineers, not the operators of engines. A steam drill is an engine, yet we do not call the runner or operator an engineer, but a drill runner; the same with dredges, steam shovels and elevators. Why should locomotive runners or drivers be called engineers?

It would seem proper that the creator of the engineering appliances should be called the engineer. Would the janitor be called an architect because he looks after a finished building? If, on the other hand, we associate the engineer with the steam engine, why should we say "bridge engineer." A bridge is certainly not an engine; more properly it is a contrivance.

As the word "engineer" now has a fixed and proper meaning, namely, persons engaged in the science of engineering, it behooves the engineering journals to eliminate as much as possible from their pages the use of this word when speaking of engine operators, runners or drivers. To call a tug engine operator a "marine engineer" is the height of absurdity. EMILE LOW.

Buffalo, N. Y.

Bituminous Foundations for Sheet Asphalt Surfaces

Sir—The comments, in your issue of July 26, p. 178, of H. W. Skidmore, construction engineer, Department of Public Works, Oak Park, Ill., on Lester Kirschbraun's able article commending bituminous-concrete foundations for sheet-asphalt surfaces (see *Engineering News-Record*, June 21, p. 591), makes reference to the paving contractor and chides that lowly, modest individual for not placing his ideas under the limelight more frequently, as does the engineer. It might interest Mr. Skidmore and others to know that asphalt-paving contractors in the South are interested in the bituminous-concrete foundation, and have published a specification of the same, and are endeavoring to "educate" Mr. Skidmore's brethern in the engineering profession regarding the merits of this proposition.

Washington, D. C., has many old and successful pavements laid on bituminous-concrete foundations, some over 30 years in service. It is likewise noticeable that

some of the best asphalt pavements laid on cement-concrete base in the same city have a mix in the base of 1:4:10 as against the customary 1:3:6 mix. These latter pavements were laid years ago under the paving administration of Dr. A. W. Dow.

The advantages of the bituminous-concrete base for sheet-asphalt wearing surfaces are fully covered in the Kirschbraun paper. There are additional advantages to the asphalt-paving contractor in that he can perform all his work with one organization—that of his asphalt plant and asphalt-paving gang—reducing expenses and saving time. Moreover, the work can be completed quicker. Base can be laid one day, sheet surface the next, and the third day the street opened to traffic.

Contractors are fully aware that cement-concrete foundations crack, and these cracks carry upward through the asphalt wearing surface, no matter how carefully the cement-concrete foundation and the asphalt wearing surface have been constructed. The contractor has been obliged to repair too many of these cracks under his five-year maintenance guaranty not to know it. He knows, too, that cement-concrete foundations for pavements draw water up from the subgrade and that this moisture in time has a tendency to disintegrate the bottom of the bituminous wearing surface. Such wearing surfaces wear from the top, but disintegrate from the bottom. The thoroughly waterproof bituminous-concrete foundation absolutely protects the asphalt wearing surface from moisture action from below, because asphalt is a well-known waterproofing agent.

The foregoing facts are very respectfully referred to S. H. Lea, city engineer, Charlotte, N. C., who in your issue of July 12, 1917, opposed the arguments set forth by Kirschbraun. Lea claims a cement-concrete base is preferable to a bituminous-concrete foundation, because he says the cement concrete provides a "firm unyielding foundation acting as a bridge over soft spots in sub-base." The answer to this is that "soft spots in the sub-base" ought to be made sound before any kind of foundation is laid. Moreover, hidden weak spots in the sub-base are disclosed under the action of rolling a bituminous-concrete foundation, whereas cement-concrete foundations are not rolled and, therefore, hidden weak spots in the sub-base are ordinarily not disclosed until the pavement is completed, and then by the action of traffic.

Mr. Lea likewise referred to the article of Professor Smith, of the University of Michigan, which relates how cement-concrete pavement foundations "suck up water" from the ground beneath—as an authoritative answer to his second contention that cement concrete furnishes "freedom from injury by water or dampness."

The pavements Mr. Lea refers to in his home city of Charlotte, N. C., which served with the least degree of satisfaction, were laid many years ago, on a rolled stone base, and this type of construction must not be confounded with the plant-mixed bituminous-concrete foundation, advocated by Kirschbraun, George C. Warren, of Boston, and other leaders in the bituminous-paving industry. Many paving contractors are also advocates of this type of construction. L. B. West, president, West Construction Co., Chattanooga, Tenn., has had 27 years' personal, practical asphalt-paving experience and informs the writer that he agrees with Kirschbraun in every particular.

GEORGE B. MCGRATH,
General Manager, Southern Purchasing Co.
Chattanooga, Tenn.

Sir—In reading Mr. Kirschbraun's article on "Bituminous Foundations for Sheet-Asphalt Surfaces," in *Engineering News-Record* of June 21, p. 591, I was reminded, by his reference to "a perfectly good asphalt pavement," of some paving work in the City of Chicago, which came directly under my observation, late in the summer of 1916.

The street in question had been paved with macadam, which was removed before the concrete base was laid. The stone obtained from this macadam base was screened to remove the fine particles, and this same stone, without any further cleaning, formed the greater part of the coarse aggregate for the concrete base for the new pavement. Each individual stone was almost completely covered with a film of dirt, and the whole was utterly unfit for use. After this concrete base had been in place for 10 days, it was possible to pull these stones out with the fingers wherever the base was rough enough to allow one to get hold of them.

The amount of cement used in this work was correct for a 1:3:6 mixture, but the mixing was poor, as it was unusual for a batch to remain in the mixer for more than one minute.

In view of these facts, I could not help wondering if the failure of the paving referred to by Mr. Kirschbraun was not due to faulty construction, rather than faulty design.

H. W. ROBERTS.
Chicago.

Training City Managers

Sir—The article on "Training City Managers," by Murray P. Horowitz, in your issue of Aug. 2, is timely. It indicates the close relationship between sanitary and municipal engineering and municipal government. Students who have been trained as sanitary engineers have, after entering practice, often found that their work in sanitation was bound inextricably with problems of municipal finance, administration and politics.

In the large majority of cities under the city-manager form of government, the city manager is a civil engineer. The reason probably is that the civil engineer, of all municipal employees, has had the best scientific training along broad lines. There have been until recently few other municipal employees with special training and experience in administrative work. The health officer generally has been a physician in private practice, with little experience in public health work. The chief of police is sometimes a capable officer, rising from the ranks, but often is appointed without reference to his ability to protect the public or to his knowledge of penology. The city clerk has had a clerical training and generally has had little executive responsibility. The city attorney may or may not have had the business or executive training required. But the city engineer has been required not only to know the physical characteristics of his city and to plan and design public improvements, but he has also had to employ and manage men, to purchase materials

on precise specifications, to devise an accounting system, to keep cost records, to coöperate with the health officer in sanitary improvements, to work with the city attorney on contracts and bond issues, to work with the assessor on special assessments and often to prepare building ordinances which require the coöperation of the Fire Department. He also has had the difficult work of meeting public opinion or public apathy.

Of all the municipal problems which demand public attention, probably none are more important than those of transportation, both external and internal. These are essentially of an engineering nature. Franchises and valuations depend largely upon the physical properties, of which the engineer has first-hand knowledge.

The introduction of the idea of business and efficiency into city government has brought forth a realization in the form of the city-manager form of government, and the engineer has been forced into the field because he has been found to meet the requirements more nearly than any person of other training.

The paper written by Mr. Horowitz is therefore a timely reminder of the trend in city government and the broader opportunity which is open to city engineers who may prepare themselves by study of the municipal problems lying outside of the narrower fields of engineering strictly limited to physical problems. It calls attention to the fact that the engineer is a greater potential power for good government than has generally been realized by the public.

If one will scan the catalogs or bulletins of the leading universities, he will see that a student may avail himself of a range of interesting and profitable courses in the social sciences and engineering in many institutions. Engineering faculties in some of the state universities have recognized this development and have made special arrangements for the training under discussion.

FREDERICK BASS,
Department of Civil Engineering, University of Minnesota.

The Wilson Ave. Tunnel, Chicago

Sir—In your article on "Making Surveys for Land and Lake Tunnel at Chicago," in *Engineering News-Record* of July 26, 1917, you state that the Wilson Ave. Tunnel is being built by city day labor under the direction of H. W. Clausen. Permit me to inform you that this tunnel is built by day labor on the recommendation and under the direction of the city engineer, who is held responsible for this work. Mr. Clausen is one of ten division heads reporting to the city engineer, and is placed in direct charge of this work by the city engineer.

JOHN ERICSON,
Chicago, Ill. City Engineer.

Everglades Drainage District Considered Merits of Engineers

Sir—On p. 237 of *Engineering News-Record*, issue of Aug. 2, 1917, I note a news item, "Everglades Drainage District Gets Engineer." From the concluding paragraph of that item it would appear that the district selected its engineer on the basis of competitive bids for engineering services. This is misleading. The district did receive proposals from several different engineers, but that of Isham Randolph & Co. was not the lowest. The selection of engineers for the district was not made on the basis of competitive bids, but was made after the district had thoroughly considered the merits of different firms according to their own views.

We have always felt that competitive bidding among engineers was a practice to be discouraged, and I am sure that you will be interested in knowing that on a project of this magnitude, unfair methods were not employed.

GEORGE B. HILLS,
Engineer Manager, Isham Randolph & Co.
Jacksonville, Fla.

Market St. Bridge at Chattanooga

Sir: In your issue of July 26, 1917, p. 170, I note an article referring to the Market St. Bridge at Chattanooga. This article contains certain errors of fact to which the attention of your readers should be called.

This bridge was designed by the writer and with the exception of the bascule was built under his direction and supervision. The steel bascule span was designed by the Scherzer Rolling Lift Bridge Co., under the direction of the writer.

J. E. Greiner was not retained as advisory engineer until February, 1916, by which time the concrete was three-fourths completed and part of the steel had actually been fabricated.

The general contractors for the masonry were the Vang Construction Co., of Cumberland, Md., and for the structural steel span, the Toledo Bridge and Crane Co., of Toledo, Ohio, who employed the Kelly-Atkinson Co. to do the erection work.

B. H. DAVIS,
New York City. Consulting Engineer.

To Counteract Settlement of Approach Fills

Sir—When bridges are built with high abutments in paved roads or streets and the pavement is laid on the approaches very soon after the completion of the bridge—a procedure which is often hardly avoidable—there is usually much trouble with the settlement of the filling adjacent to the abutment, which makes a very unpleasant bump for automobilists and others.

To mitigate that evil I would suggest that a ledge be formed in the rear of the back wall in such a position that the concrete foundation for the paving may rest thereon. This concrete foundation should be cut about fifteen (15) feet back of the back wall, or more if much settlement is anticipated, and strongly reinforced so that the slab thus formed will bridge over the cavity left by the settlement of the filling and thus form a kind of a ramp instead of the usual bump. Of course when the filling has thoroughly settled the paving should be removed and the filling brought up to grade and proper pavement constructed. It is often advisable, where traffic must be reëstablished as soon as possible to pave the roadway temporarily with broken stone with a top dressing of gravel or screenings, or a stone block pavement on a gravel foundation. These pavements are easily built up or repaired as the settlement proceeds and this road can be kept in very fair condition. This requires, of course, an organization equipped to make repairs promptly at the proper time.

WILLIS WHITED, Bridge Engineer,
Pennsylvania State Highway Department.
Harrisburg, Penn.

THE ENGINEER IN FIELD AND OFFICE

A DEPARTMENT DEVOTED TO DETAILS OF THE DAY'S WORK

Old Stone Arch Has Curious Wing Walls

A masonry arch bridge built in 1871 at La Salle, Ill., has a peculiar arrangement of stone in its wing walls. As shown in the view, these walls are arched in plan and elevation, forming a part of a dome-like surface in which the stone are laid with beds normal to the top slope of the wall. These stones, laid almost as voussoirs

WING WALLS OF FORTY-SIX-YEAR-OLD ARCH HAVE DOME-LIKE SHAPE

of an arch, are flat and of nearly uniform size. The arch itself, as well as the wing walls, is of limestone, laid in cement mortar.

The bridge, carrying a country road across Vermilion Creek, is locally reputed to be the work of E. C. Hegeler, the famous zinc metallurgist, who lived in La Salle. It is stated that the curve of the intrados is a true catenary, determined by suspending a log chain of suitable length and measuring the ordinates. The span is 75 ft., the rise 15 ft., and the uniform thickness of the rib 3 feet.

Concealed Wood Strips for Transverse Joints in Concrete Pavement

BY S. E. FITCH
Senior Assistant Engineer, New York State Highway Department

MANY of the troubles attending the use of transverse joints in concrete pavements can be avoided by installing at the bottom of the slab a ⅜-in. wooden strip of about half the depth of the concrete. In this manner planes of weakness where transverse cracking may concentrate, are definitely located.

Four joints of this type were installed under the writer's direction in 1915, and withstood the following winter without cracking, although fine hair cracks appeared in June, 1916. These cracks were very narrow and followed a zigzag line around the individual stones of the concrete directly over the wooden strip. The zigzag cracks nowhere departed more than 2 in. from a straight line. These cracks were exposed to traffic all summer, and no spalling of any kind has been noticed.

The result was so satisfactory that in 1916 the writer installed 10 consecutive joints of the same type on each of two roads. These have gone through one winter and are now in excellent shape. Fine hair cracks have appeared over most of the joints, but the fact that the pavement has not yet cracked over a few indicates that the slabs might have been made somewhat longer than 30 ft. in this particular locality. In no case has the pavement cracked, except over the wooden strips.

SEVERAL ADVANTAGES ARE SECURED

The advantages obtained by this method over other types of joints are: (1) No spalling along the joints; (2) no interference with screeding or floating, and a much smoother pavement; (3) the joints are cheaper and easier to install, the wood may be of cheap material and need not be creosoted; (4) better appearance of the road.

The advantages of this method over no joints at all are that by choosing the proper length of slab to correspond to the width of pavement and to climatic conditions the cracks will be minimized and will run square across the pavement at regular intervals instead of occurring haphazard and running in every direction.

It is absolutely necessary that the top of the joint be kept below the surface of the slab a sufficient distance to give body enough to the concrete over it to prevent spalling. This minimum depth has not yet been definitely determined, but from observations already made, a distance of 2½ in. near the edges and 3½ in. near the center of the pavement seems to work out very well. Should this distance be much greater, it probably would necessitate decreasing the length of the slab in order to insure the cracking at the joints only.

A simple way to prevent the rising of the wooden joints up through the concrete is to drive short pegs at intervals of about 7 ft. across the road and nail through the strip into the pegs. Bent wires hooked over the joint would answer the same purpose. The strips should be installed by means of a taper installing board in the usual manner.

While no spalling has occurred on any of the joints mentioned, it is realized that "one swallow does not make a summer," and it may prove to be advisable to treat these cracks with a small amount of bituminous material as soon as they appear, especially on roads of heavy traffic. So far as these experiments go, the writer believes that the resulting fine cracks are as satisfactory joints as he has yet seen.

Cast-Iron Pipe Connects Wood-Stave Pipe with Concrete Structures

THE connection of a wood-stave pipe with a concrete structure is a troublesome detail. Quite often the end of the pipe is inserted into a socket left in the concrete. Subsequently the ring left around the pipe is grouted. While this method is still in use it has been the cause of some failures in wooden siphons in Wyoming, for the repair cannot be made easily when necessary to replace the staves.

One engineer handles the problem by embedding a cast-iron pipe in the concrete and then fitting the wood pipe over it. To make a water-tight joint and one that permits expansion and contraction, the cast-iron pipe is wrapped with tar-soaked oakum for a distance of 4 ft. Beginning at a point 15 ft. from the end of the pipe, the internal diameter of the wood pipe is increased by tapered staves to fit the outside of the wrapped pipe.

Unusual Road Drainage

A few miles east of Wooster, Ohio, on the Lincoln Highway, is an unusual solution of a road-drainage problem. The road from Wooster east at this point dips from a comparatively level stretch to a grade of some 6 to 8% (which is being paved with monolithic brick). Across the ridge where the road begins to dip is an intersecting road at right angles. At this point there was evidently a culvert pipe on both sides, while open ditches were provided for drainage of the side hill and to carry considerable accumulated water from the more level place above.

To avoid scouring on the deep side ditches on the improved road, about a 30-in. corrugated-iron culvert pipe extending from the crest of the hill to a creek at the foot of the hill (about 300 ft.) has been installed. Apparently it is not intended to be covered. Drainage water from the level stretch on the opposite side of the road passes through a culvert pipe at the crest and then is conducted diagonally across the roadbed into the large culvert pipe by a segmental cast-iron culvert pipe, forming the unusual-looking structure shown in the accompanying view.

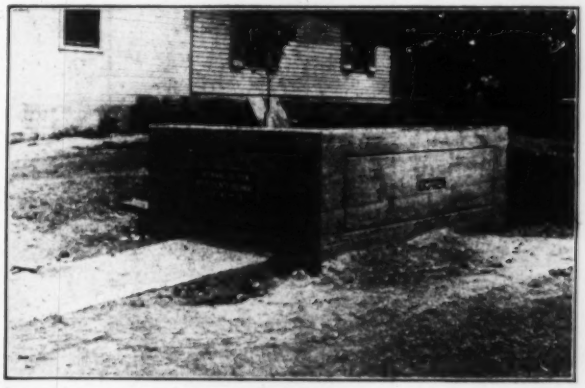
UNUSUAL DRAINAGE, LINCOLN HIGHWAY, OHIO

Street Signs Show House Numbers

It is sometimes hard, even to one who is acquainted with a city's streets, to tell from the corner signs just how near he is to the particular house number he is seeking. If the seeker is in a street car, the situation is aggravated. Particularly is this so in cities where the house numbers bear no relation to the distance of the cross-streets from a meridian street. The new style of street sign adopted by Cincinnati, Ohio, avoids this difficulty. All streets having car lines are now supplied with the new signs, which show on a separate panel the numbers of the corner houses. This is an admirable advance over the design used for the more important street signs of New York City, which show the crossing street in smaller-size lettering above the indicated street.

Every Culvert Has Its Number on a Cast-Iron Plate

HAMILTON COUNTY, Ohio, of which Cincinnati is the county seat, places a cast-iron sign with the name of the highway and the number of the culvert on the parapet and wing-walls of every culvert. The accompanying illustration shows a culvert at the intersection of two roads, the Cincinnati-Dayton intercounty highway and the road at right angles, Kemper Road. The number of the culvert is 18. These signs are a great convenience to tourists and also assist the office record system.



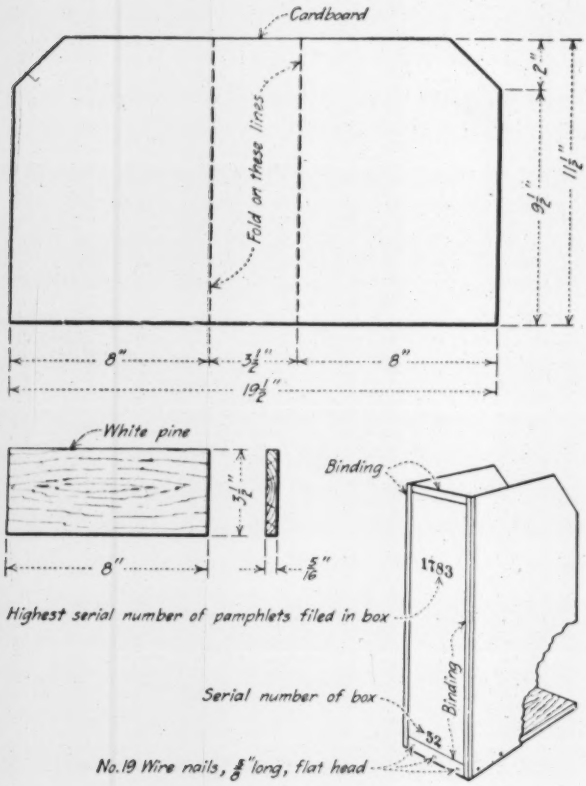
NUMBER OF CULVERT AND NAME OF ROAD HELP OFFICIALS AND TOURISTS

Pamphlets Indexed and Filed by Simple System

PAMPHLETS in great variety, principally bulletins and reports, are available in constantly increasing number and comprise a very important class of current literature. The value of the information which they contain is, however, considerably lessened if they are not indexed and filed in a manner which facilitates easy reference to their contents. Indexing and filing pamphlets by the following plan has been found to be a simple matter and to give satisfactory results as to convenience of reference.

As soon as convenient after receiving, the pamphlet is read, or at least inspected to ascertain the character and scope of its contents. As this is being done such index cards as are thought desirable are written. For this purpose the writer prefers to use very thin 3-in. x 5-in. cards ruled horizontally and made up in pads. For this and general notebook purposes it is convenient to carry a number of these cards in a loose-leaf notebook.

The index cards are then placed together in the pamphlet until it proves convenient to assign serial numbers to the pamphlets for filing purposes. A simple record of the pamphlet numbers assigned is kept by filing with the pamphlets a 6-in. x 9-in. card on which the last serial number assigned is noted each time. It has been found most convenient to place the numbers on the upper right-hand corner of the index cards and on the upper left-hand corner of the pamphlet cover. This numbering may be done by hand, though a numbering machine does the work more neatly and



FILING BOX IS EASILY MADE

quickly. A very satisfactory substitute is a rubber-stamp numberer, similar in construction to the familiar band dater.

The pamphlets are then filed in the order of their serial numbers from left to right on shelves or in bookcases. A decidedly neater appearance is given the collection when filed in pamphlet boxes. It will be found a simple matter to make up these boxes as needed after the construction indicated in the illustration. Where heavy cardboard is used, the bending is facilitated by making a very light knife cut on the fold lines. A neat appearance, as well as a stronger box, results when the exposed edges are bound with gummed cloth tape or the gummed paper strips used in binding lantern slides. Each pamphlet box should carry a serial number as well as a number corresponding to the highest serial number of the pamphlets that are filed in the box.

In the writer's opinion the filing of pamphlets by arbitrary serial numbers is far more simple, elastic and generally satisfactory than any attempt to classi or group these publications according to their subj matter. And any system of indexing, to be satisfacto demands the personal attention of the person who to make use of it, as the average office help can be expected to do indexing of this sort with any sat factory degree of intelligence.

Formulas for Emergency Disinfection with Hypochlorite

By Joseph Doman
Assistant Sanitary Engineer, California State Board of Health

ALTHOUGH liquid chlorine is being substituted for hypochlorite in modern water-purification plants, hypochlorite is more adaptable for emergency or temporary purposes, due mainly to ease in obtaining the chemical and low cost of installation. In such cases the formulas in the accompanying table will be found simple and useful for the rapid calculation of dosage and operating quantities. While it is always advisable to have the bleach and main solution tested for available chlorine, this is often omitted, giving rise to three different methods of operation.

The formulas have been grouped so as to apply to all of these methods. In Group I, in the table, the available chlorine in the main solution is known; that in the bleach may or may not be known. In Group II, only the available chlorine in the bleach is known. In Group III, the available chlorine is unknown in both bleach and main solution. In this case, approximate dosage in terms of chlorine may be obtained by assuming a value for the available chlorine in the bleach and using formulas in Group II.

It is interesting to note that with slight changes in the notation given beneath the table and eliminating formulas involving the term P, the equations in the table can be applied to other chemical treatments, such

OPERATING FORMULAS* FOR HYPOCHLORITE DISINFECTION

Quantity Sought	Equivalent to Quantity Sought		
	Group I	Group II	Group III
D	$\frac{10{,}000\ AH}{L}$	$\frac{833\,A}{P}$	$\frac{10{,}000\ HR}{G}$
A	$\frac{LR}{G}$ or $\frac{DL}{10{,}000\,H}$	$\frac{DP}{833}$	.....
R	$\frac{AG}{L}$	$\frac{AG}{12\,PH}$	$\frac{DG}{10{,}000\ H}$
H	$\frac{L}{12\,P}$ or $\frac{L}{12\,PH}$	$\frac{AG}{12\,PR}$ or $\frac{AG}{12\,PH}$ or $\frac{100\,SP}{R}$	$\frac{DG}{10{,}000\ R}$ or $\frac{8.33\,S}{\ldots\ldots}$
L	.....	.....	.....

* Formulas for Group III apply to Group II. Formulas for Groups II and III apply to Group I. The notation is as follows:

A = Available chlorine applied to raw water, p.p.m.;
D = Bleach applied to raw water, lb. per 1,000,000 gal.;
R = Rate of application of dosing solution, gals. per 24-hour day;
G = Rate of flow of treated water, gal. per day;
H = Strength of dosing solution, lb. bleach per 100 gal.;
S = Strength of dosing solution, per cent.;
P = Available chlorine in bleach, per cent.;
L = Available chlorine in dosing solution, p.p.m.

as lime, alum, soda ash and the like. The notation should be modified so that A = amount of chemical applied to raw water, p.p.m.; D = amount of chemical applied to raw water, pounds per 1,000,000 gal.

Adding to the above modifications, the term C = chlorine applied to raw water, pounds per 24 hours, the following formulas apply to liquid-chlorine practice: $D = 10{,}000\ C/G$ and $A = D/8.33$.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

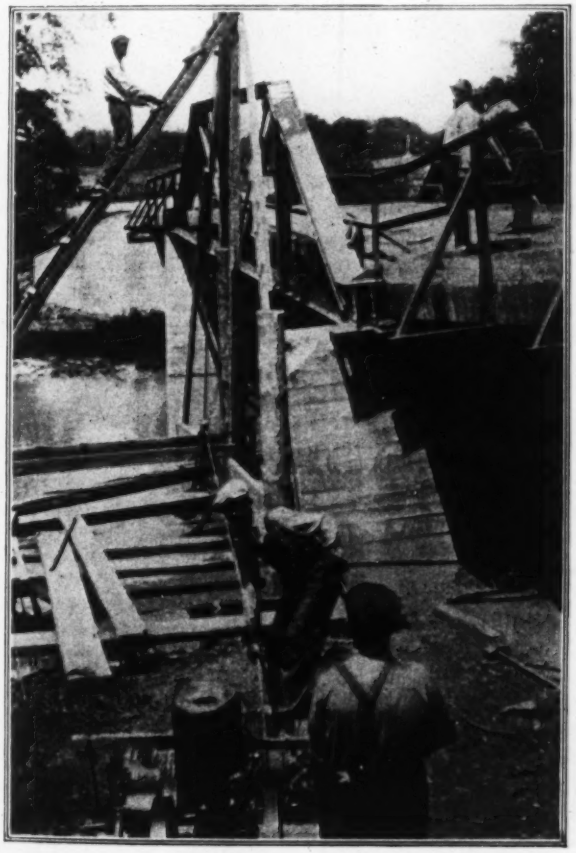
Simple Jacking Platform Facilitates Bridge-Pier Replacement

By R. T. Brown

County Highway Engineer, Lexington, N. C.

TO REPLACE a pier undermined by a heavy flood in 1916, the bridge shown in the photograph was jacked up and held by supporting it from a platform made by letting the flanges of I-beams into the opposite sides of pile supports, and clamping them with bolts. This took the bearing off the bolts and saved complicated framing. The bridge was rather heavy, consisting of a 50-ft. pony truss and two 36-ft. girder spans. The bridge carried a 16-ft. concrete roadway 5 in. thick.

The flood referred to undermined one pier so that it settled 6 in. at one end and 18 in. at the other. This threw the bridge slightly downstream. The floor, however, which was well reinforced, was scarcely cracked. Four piles about 30 ft. long were driven around the settled pier with a 660-lb. hammer to a penetration of about ½ in. per blow. These piles were spaced so as not to interfere with the replacement of the old pier.



BRIDGE SETTLED AND MOVED SIDEWISE

FLANGES OF PLATFORM BEAMS LET INTO PILES

Two 15-in. I-beams with their flanges let into the piles were then bolted transversely to the roadway. Bearing on these I-beams, and with their flanges also let into the piles, were two 8-in. beams parallel to the axis of the bridge. Another set of beams was bolted to the piles in the same way lower down to carry a jacking platform. From this platform, by means of two 60-ton hydraulic jacks, the bridge was raised to its proper position and blocked from the upper set of beams. The old pier was then removed with small charges of dynamite. Holes were next cut in the concrete floor of the bridge to permit driving foundation piles for a new pier. These holes were left open and used later to pour the concrete for the new pier.

In this way, what promised at first to be a very difficult job was safely completed at low cost and without interrupting traffic on the bridge at any time. The work was carried on under the direction of the writer as engineer and D. T. Beish as superintendent.

Shovel on Wide-Span Carriage Saves Labor in Laying Big Concrete Pipe

JAMES O'Donnell & Sons, general contractors, of Vincennes, Ind., are saving labor in laying large pre-cast concrete sewer pipe by using a steam shovel with a wide carriage traveling on a timber track both to complete the trenching and to handle, with a special hook, the 84- and 72-in. diameter 4-ft. sections of 6-in. concrete pipe, which weigh from 5 to 6 tons apiece. With a crew of five men 40 ft. of this sewer is regularly completed in a day at Columbus, Ohio.

The excavation for a trench 15 or more feet deep is made after first breaking a long stretch of pavement over the trench with a 1600-lb. cast-iron ball

handled by an Osgood No. 18 shovel with the dipper and dipper boom removed, using only the hoisting tackle. This is very efficient for breaking the concrete base of the brick pavement encountered.

The first 6 or 8 ft. of the trench excavation is then taken out with a Keystone shovel rigged with an elbow boom. Two men are required to operate this machine. Following not more than 100 ft. behind comes the Osgood shovel, specially mounted on an I-beam truck having four very wide flanged wheels. These wheels travel on a track of 12 x 12's laid well back from the edges of the trench. The gage of this track is 18 ft. The scheme of moving the shovel in this manner is claimed to be original with this contractor, the usual method being to have the shovel mounted over the trench on a platform of 12 x 12's, which must be laid in advance as the shovel moves. The balance of the excavation left by the Keystone shovel is removed with a clamshell bucket. The operation of the shovel with bucket attachment requires the services of a third man. Two other men work in the trench sheeting it and cleaning it to grade.

As soon as the trench has advanced far enough to place two or more sections of pipe, the clamshell bucket is detached from the shovel boom and is replaced by a yoke which is used to lift the sections of pipe. The pipe is placed in final position by the shovel alone. The ease with which the shovel can be moved longitudinally makes the most delicate adjustment of the sections of pipe possible. The yoke for holding the pipe is made of two pieces of I-beam fastened together at one end by another section of I-beam filler about 7-in. high. This forms a U-shaped yoke, one leg of which goes inside the pipe. The other leg carries three eyebolts to which the hoisting line is attach Two lines are attached which meet about 3 ft. ab the yoke. The three eyebolts and shackles permit of the lines to be moved from one eyebolt to anot if it interferes with the cross-bracing of the trenc without releasing the pipe. The use of the three ey bolts and two hoisting lines make it possible to exe considerable leverage on the pipe and thus make a ver snug-fitting joint.

The pipe, made under patents owned by the In dependent Concrete Pipe Co., of Indianapolis, is cas on the street at the point where it is to be used. It is reinforced with ¼-in. steel wire hoops which are held on four slotted steel uprights. The work is part

SHOVEL MOUNTED ON WIDE CARRIAGE FINISHES TRENCH AND HANDLES CONCRETE PIPE TO PLACE

of the extensive new sewer construction being carried out under the direction of City Engineer Maetzel.

Small Tail Gate in Dump-Body Truck Spreads Stone in Ruts

THE STATE highway engineer of Tennessee has devised a method of dumping stone or gravel in wheel ruts by using a small tail gate which lets the material out in a narrow stream. The county of which Nashville is the center owns a Kelly-Springfield 5-ton truck with a detachable steel dump body. In addition to the usual tailboard, an 18-in. wide by 12-in. high opening has been made, with a sliding door, so that instead of dumping the stone the full width of the truck, only an 18-in. wide stream may be discharged. The truck is then driven so as to center over the rut to be filled and the elevation of the body and the speed of the truck adjusted so as to give just the right amount of gravel or stone to fill the rut.

Steam Shovel Wrecks Deep Basement and Loads Motor Trucks on Street

ONE HUNDRED 5-yd. truck loads of material a day were hauled from an 8-story building in the Chicago loop district which was wrecked recently. The trucks were loaded at street level by a Bucyrus steam shovel provided with an extra-long dipper stick. Ordinary wrecking operations removed the floors above the street level, but everything below, including masonry basement walls, partitions and débris, was handled with the steam shovel. The W. J. Newman Co. was the contractor.

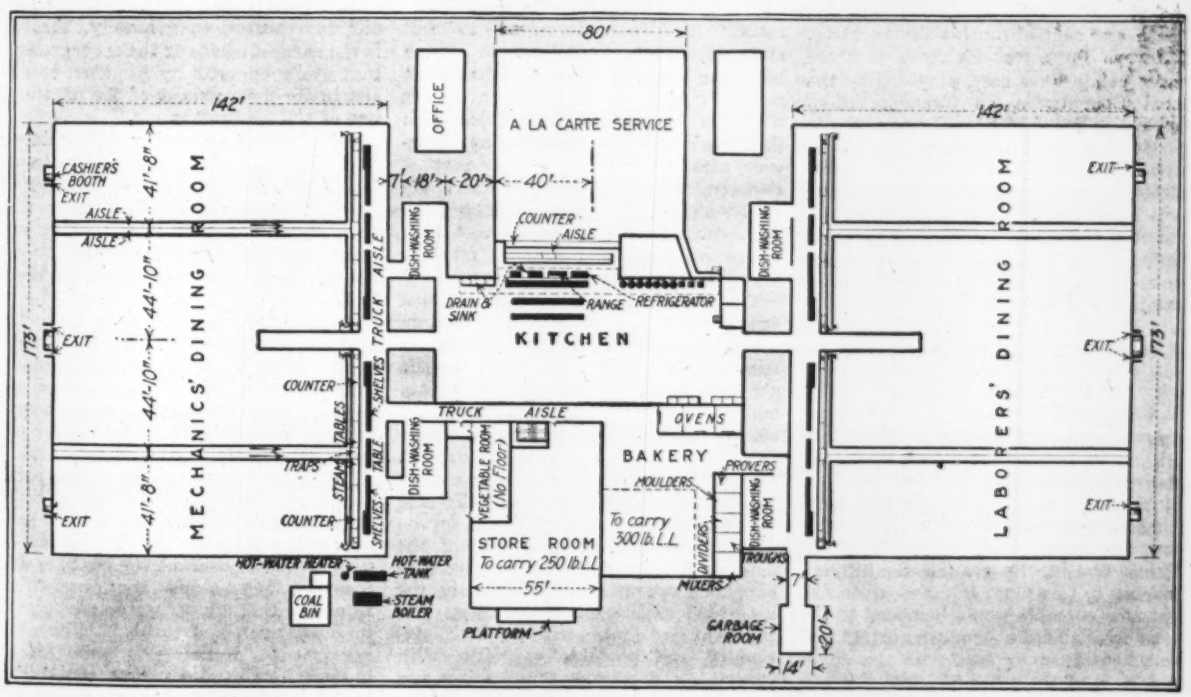
STEAM SHOVEL EXCAVATES OLD BASEMENT
21 FEET DEEP

Cafeteria Idea Works Well in 3000-Man Contractor's Camp

SELF-SERVICE for the pipefitter, carpenter and trench digger is the order of the day in the contractor's commissary at the new army cantonment at Ayer, Mass. Moreover, the men receive their full wages and pay cash for their own meals, or buy meal tickets. The number of men required to operate the dining-room is reduced, the waste is cut down, and the entire commissary is kept under better control.

It might be argued by those used to dashing into the long dining-hall at the sound of the dinner gong to find a meal all ready spread out on the table for them, that self-service would not only take up the entire time allowed for meals, but would make it impossible to feed a large number of men within the time available. On the contrary, however, two cash registers and "loading" counters have already proved ample for handling 2000 men at a meal. Before the completion of wooden dining halls, the men took their meals on trays to tables under a pair of large tents as a temporary expedient.

This innovation in the accepted process of feeding contractor's men is due to the management of Baldwin's, Inc., a large restaurant firm, consulted on the subject by Fred T. Ley & Co., contractors for the cantonment, which is being built for the U. S. Government under the direction of Captain Edward Canfield, Jr., constructing quartermaster of this cantonment.



MEN PASS DOWN CENTER AISLES PAST SERVING COUNTERS AND CASH REGISTERS, AND OUT ADJOINING AISLES INTO DINING HALLS

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Chicago Wants More Through-Route Streets

Association Has Been Organized To Promote Plans Now Before Improvements Board

An association to promote the opening of certain streets to form additional through routes has been organized in Chicago. The improvements are already under consideration by the Board of Local Improvements and the Chicago Plan Commission. The most important work desired is the extension of Ogden Ave. This is a diagonal street in the southwest district, but ends at Union Park, on the west side. By extending it 2½ miles to Lincoln Park, it would give a direct connection between crowded tenement districts and the lake front and also a more direct route for much team traffic which now has to go through the congested business district. It is proposed to make the extension 108 ft. wide. Surveys for this have been started by the Board of Local Improvements, and will occupy several months. Until these are completed, the location and cost cannot be decided definitely.

Another improvement is a link in Ashland Ave., across the north branch of the Chicago River, to connect the north and south sections of this thoroughfare. The opening up of Robey St. to form a continuous thoroughfare includes similar crossings of both the north and south branches of the river. Subways for street-car lines at these three points have been proposed by the local Commission on Transportation, but if the Board of Local Improvements undertakes these extensions it will be with the idea of developing a complete street in each case, and subway work will be avoided if possible. However, the Ashland Ave. and Robey St. extensions cannot be considered by the board until the surveys for the Ogden Ave. extension have been completed.

Large Grading Project Proposed for San Francisco

A plan for the removal, at a cost of approximately $4,000,000, of Rincon Hill, an eminence in San Francisco near the waterfront on the south side of Market St., was recently submitted to the Board of Supervisors by H. A. Mason, ordinance expert of the Board of Public Works. By grading the hill, according to this plan, 40 acres which are not now valuable would be added to the area available for manufacturing and warehouse uses.

A part of the scheme is that the material taken out could be used to fill in the vicinity of Islais Creek so as to add about 60 acres to the waterfront land there. The estimated value of all lands thus made available is about $6,000,000. The expense would be defrayed through assessment districts, plans for which are included in an ordinance drawn up to accompany the report.

A public hearing will be held at an early date under the auspices of the Lands and Tunnels, Commercial Development and Finance Committees of the Board of Supervisors, to which the matter has been referred.

Oregon Will Make New Roads Wider

Two decisions made recently by the State Highway Commission of Oregon were, first, to build all paved roads 16 ft. instead of 12 ft. wide, and, second, to urge the Government to develop the economic roads before the strictly scenic roads are improved.

Paving contracts heretofore awarded by the commission were for 12-ft. pavements. From all parts of the state there has been complaint that 12 ft. is too narrow and a 16-ft. width has been demanded.

Want Men for Possible Second Lumberjack Regiment

The regiment of lumbermen, officially known as the Tenth Engineers (Forest) and nicknamed the "Lumberjack Regiment," has been recruited to full strength, and the Forest Service, which has been securing the men, has been notified by the War Department to list no more candidates for service with this regiment. In anticipation, however, of a possible call soon for another regiment of the same character, the listing officers all over the country have been instructed to continue listing names of suitable men who may be summoned when needed.

The "Lumberjack Regiment" is not a fighting force, but will be employed in woods operations in France, getting out material for army use. The recruits are now being assembled in Washington, where they are drilled daily by the officers assigned to command them. Colonel Woodruff, of the regular army, who will head the regiment, is in charge and, with the assistance of a staff made up of practical lumbermen and foresters, is providing an equipment of the most up-to-date character for the type of woods operations called for in the list of the experience of the allies. The regiment will take with it both stationary and portable sawmills, with everything necessary for logging and sawmill work and for transporting the product.

Attempt To Cut Off San Diego Water-Supply Failed

Authorities Have Clues to Identity of Persons Who Dynamited Supply Conduit

Editorial Correspondence

A futile attempt to cut off the water-supply of San Diego, Calif., and the military bases at Fort Rosecrans and the Camp Kearney cantonment by dynamiting the 40-in. wood-stave supply conduit was made at 11 p.m., Aug. 17. The net result was two broken staves, which were replaced in seven hours. Meanwhile water was drawn from an emergency reservoir. The authorities have clues by means of which they expect to apprehend the miscreants.

One Railroad Official Urges Waterway Use

The vice president of the Chicago, Burlington & Quincy R.R. has sent a letter to the freight representatives of his company in which he strongly urges them to do everything in their power to promote the use of inland waterways for freight transportation. The main parts of the letter follow:

"There is every indication that for some time to come the traffic offered for transportation in this country will be in excess of the capacity of the rail facilities which are available. I want to reiterate to you, and through you to our representatives generally, that it is the earnest desire of the management that every opportunity be taken to assist in the development of the practical use of the waterways.

"We have been rather disappointed that since the issuance of the Railroad War Board's bulletin No. 18, under date of June 22, there has apparently been very little done in perfecting arrangements for larger interchange of traffic between the water and rail lines in this territory, and I wish that, if you have not already done so, you would at once make it plain to all the steamboat companies, also to chambers of commerce and other organizations interested in water transportation development, that we wish to extend our co-operation.

"Some of the steamship people, shippers and the public generally have in the past been inclined to the view that the railroads would by all means in their power discourage the use of water facilities by making low competitive rates and through refusal to participate in joint rates and through billing arrangements, declining to build tracks to docks, etc., and we want, if possible, to have this view changed as quickly as possible."

Court Announces Findings in Water Rate Case

Spring Valley Water Co., of San Francisco, Master Decides, Is Entitled to $2,250,000 Impounded Rate Money

The Spring Valley Water Co., of San Francisco, is entitled to the $2,250,000 impounded rate money held by the United States District Court, according to a report recently made by H. M. Wright, master in chancery. This report will be filed Sept. 7 with Judge Van Fleet, of the United States District Court, for his approval or rejection. Meantime the city is preparing objections to the findings and there is likelihood of a long legal contest, probably carrying the case into the United States Supreme Court.

In 1907 the Board of Supervisors of San Francisco fixed rates at which the private company should sell water, and which decreased by about 19% the rates established by ordinance in 1902. In 1908 the 1902 rates were reënacted with slight modifications. These rates continued in effect until the early part of 1915. Immediately after the passage of the 1908 ordinance the Spring Valley company filed an injunction suit in the United States District Court, claiming that the ordinance fixed charges too low and that in effect its property was being confiscated under the guise of regulation.

A temporary injunction was then granted under which the company was allowed to charge a rate not to exceed 15% in advance of the scale fixed by the supervisors—this 15% difference to be impounded until the final adjudication of the matter, when the money would either go to the water company or be returned to the taxpayers. Each year since 1907 the company has filed a similar injunction suit and a similar temporary restraining order has been issued.

Master Makes Report

The report of the master in chancery just issued announces that the guiding principle in the inquiry was the rule laid down by the United States Supreme Court that rate-fixing ordinances to be valid must allow "a fair return upon the fair value of the property used and useful in the service of the public." Upon the basis of the actual revenue collected, including the 15% additional impounded by the court, it was found that the actual interest return varied from a minimum of 2.8% in 1907 to a maximum of 5.15% in 1914, and that the minimum fair rate of return which the water company should have received during these years was 7 per cent.

An inspection of all properties owned by the company was made by the master in chancery, and a valuation was placed upon it which ranged from an average of $67 an acre for lands surrounding the Alameda County sources to $1250 for the reservoir lands in San Mateo County. The total value placed on real estate was $12,930,000. A valuation of $21,537,000 was placed upon the company's structures, including dams, pipe, pumping stations, etc., in addition to which an appraisal of $3,400,000 was added to cover the going value of the property. At $90,000 per million gallons daily the water rights were figured in as $3,060,000. The difference between the total of these items, about $41,000,000, and the $34,000,000, which was the price for which the properties were offered to the city, is accounted for by the fact that certain lands were reserved in the tender extended the city.

Allowance for Depreciation

It is notable that the master's estimate of the water rights of the company ranged from $75,000 per million gallons daily in 1907 to $90,000 per million gallons daily in 1914. The value he placed on gross reproduction cost, given in the foregoing as $21,537,000, included 14% overhead and 12% interest during construction. This sum was depreciated to cover accrued depreciation in the structures by 13%, or $2,800,000, leaving the net or depreciated reproduction cost estimate $18,737,000. The master's allowance for annual depreciation reserve was based upon the compound interest method known as the equal-annual-payment method which gave amounts ranging from $156,000 in 1907 to $232,000 in 1914. In determining the operating expenses, all charitable donations by the company, all expenditures in opposing the Hetch Hetchy project and the present litigation were deducted.

The taking of testimony before Judge Wright began in July, 1915, and continued without interruption for 10 months. The evidence, comprising over 11,000 printed pages and about 235 maps and documents, is one of the most voluminous records ever presented in the San Francisco District Court.

St. Louis Gets Coal for $1.90 at Mine After a $2.75 Bid

The City of St. Louis recently advertised for bids on furnishing its supply of coal for the ensuing year. Over 120,000 tons are required for the waterworks and a large additional amount for the city institutions. The lowest bid received was $2.75 per ton at the mines in the Illinois field. Later, after a conference with the bidders, a part of the supply was offered for $2.12 at the mine. Last week an order was placed for 20,000 tons for two city institutions at $2 a ton at the mine, but no additional amount could be secured at this price. The city comptroller therefore opened negotiations directly with the mine owners and has now contracted for the entire output from the mine in the Belleville district at $1.90 a ton. The contract also carries option for the purchase of the mine by the city at a stipulated price, should the city consider it advisable to continue in the coal business.

Pennsylvania Highway Head Resigns by Request

Governor's Real Object in Asking for Resignation Alleged To Be Political Move

Favoritism and partisan politics are alleged by Frank B. Black, state highway commissioner of Pennsylvania, to be the reason why Governor Brumbaugh asked him to resign. In tendering his resignation, effective Aug. 15, Mr. Black characterizes some of the reasons advanced by the governor as "ridiculously small and insignificant"; alleges that the governor wished road funds distributed among the counties by favoritism rather than according to public interest, and then accuses the governor and his political associates of trying to turn the highway department into a political machine. The last part of Mr. Black's letter of resignation and accusation is as follows:

"The way I look at this proposition is that all the statements made by you are made with a view of beclouding the real issue for requesting my resignation. It has been my aim to run the department along business lines instead of being used as a political asset.

"I have refused consistently, as is well known both to yourself and your close political associates, to turn the department into a political machine. At your own personal order, contrary to the judgment and advice of the department, I appointed four superintendents whose appointments were insisted upon by you solely for political reasons, to take the place of men of experience, and in each case these appointees very soon realized their inability to handle the work and resigned voluntarily, which simply illustrates what it would mean if the work of the department were handled along political lines.

"Continuous efforts have been made during my administration to force changes and removals for political reasons, the practice of which I could not countenance. Such methods tend to completely demoralize any organization; cannot help but cause financial loss in handling work, because of constantly changing ineffective and inefficient personnel, and in this way the department must lose the confidence of the taxpaying public.

"Inasmuch as every indication points to the fact that it is your idea that the work of the highway department should be handled along political lines, without regard to the public's interests, it affords me great pleasure to tender my resignation, effective Aug. 15, as I do not care to be associated in any way, shape or form with works so handled.

Mr. Black was appointed by Governor Brumbaugh in August, 1916, to succeed R. J. Cunningham, recently deceased. At the time of his appointment Mr. Black was a member of the State Commission of Agriculture and was classed as a "business man," who had not held public office until he assumed the position just named.

Geological Survey To Mark and Develop Watering Places

To make the desert regions of the western part of the United States more accessible by locating their widely separated watering places and erecting hundreds of sign posts to give directions and distances to the watering places is a project recently undertaken by the United States Geological Survey, Department of the Interior. The project involves also the work of making accurate maps showing the locations of the watering places, of preparing guides describing them and giving the distances between them, of selecting well sites and of developing watering places (so far as money available will permit) in localities where water is most needed and where the geologic investigations indicate that underground supplies can be obtained.

In recent years the water-supply geologists of the Geological Survey have developed methods of locating ground water in arid regions from surface indications and of estimating the depth to water and the approximate annual yield of the underground reservoirs. These methods will be applied and further developed in connection with the survey of desert watering places.

A number of survey parties are now being organized in Washington and will in a few weeks be at work in the most arid parts of Arizona, California and Nevada. Each party will consist of a geologist and one or more assistants and will be provided with an automobile and camping outfit.

Mining Engineers Will Meet at St. Louis

The American Institute of Mining Engineers will hold a meeting at St. Louis, Oct. 8-11. As a part of the meeting there will be trips to the zinc-mining district of Joplin and Webb City, Mo., and the oil fields and refineries near Tulsa, Okla.; also to the coal fields of southern Illinois and those near Pittsburg, Kan. The latter are open-cut works, operated by steam shovels.

Adopts Electrically Operated Pumps for Sewage

The Sanitary District of Chicago has decided to adopt electrically operated pumping equipment for the new Calumet sewage pumping station at 127th St. and Michigan Ave. This is in connection with the Calumet intercepting sewer, which will carry the sewage now discharged into the Grand Calumet River and Calumet Lake. The station will pump the sewage into the Calumet-Sag Canal, a feeder of the Chicago main drainage canal. The district has invited bids on plans previously prepared. After receiving a report from A. B. Wood, of New Orleans, La., on the power to be used and the design of the pumps, and after considering recommendations by the chief engineer and the electrical engineer, it withdrew this invitation. Mr. Wood has now been appointed consulting engineer in the preparation of plans and specifications for the Calumet sewage pumping station and also the sewage pumping stations in connection with the Evanston and the Des Plaines Valley intercepting sewers, also in the remodeling of the present 95th St. station. Mr. Wood was the designer of the large electrically operated screw-pumps of the New Orleans drainage system.

Twin Cities Lay Water Pipe Though Costly

The decision of the Minneapolis Water-Works Department to make no extensions this season on account of the high cost of pipe has been overruled by the petition of property owners who want water mains regardless of cost. A total of 9.63 miles of 6-, 8- and 12-in. main will be purchased at $66 per ton and laid this season. The larger part of this will be laid in the Lake Harriet residence district, in which there has been a phenomenal building boom—also regardless of cost.

Last year Minneapolis paid $28 per ton. It is estimated that the increase in labor cost this year is 12%. The cost of water mains is assessed to the property owners. Heretofore this has amounted to a maximum of 90c. a front foot, all of which had to be paid in one payment. It is estimated that the cost of the pipe laid this year will exceed $1.30 per front foot.

In the adjoining city of St. Paul, purchases were made early in the spring for 10 miles of extensions, of which 6 miles have been laid at a premium of $25,000 over last year's prices. Extensions there are paid for by a tax of 10c. per front foot per year for 10 years.

Port Authorities Will Meet Next Month in Cleveland

The annual convention of the National Association of Port Authorities will be held Sept. 11-14 at Cleveland. The first day only will be given to the reading of papers, of which six are scheduled. The second day will be devoted to the discussion of the resolution adopted a year ago at Montreal, calling for a full investigation by the Interstate Commerce Commission of terminal and port conditions. Cleveland's harbor facilities will be inspected on the third day, and committee reports and the business meeting will occupy the fourth.

The full program of the convention can be secured from W. J. Barney, secretary of the association, 110 West 40th St., New York City.

Pennsylvania City Has Trouble Letting Percentage Work

Sewer work to total $120,000 in cost, of which $50,000 was available to be spent at once, almost went begging at Reading, Penn., last month because contractors appeared to be unwilling to bid on the work on a percentage basis. Bids were asked, according to Edmund B. Ulrich, city engineer, for furnishing all materials, supplies, labor, teams, tools and supervision for doing a certain portion of the work at cost, plus a fixed per cent. This per cent. was to cover the repair, rental, etc., on plant and equipment, and the necessary tools for the performance of the work. The sewer in question is a 20-in. diameter sanitary main to be constructed in rock tunnel below street level.

At the first letting there were no bids in accordance with the advertisement, but one firm sent in a cost-plus-per-cent. offer. At the second letting, for which bids were asked on a unit basis as well as a cost plus per cent., personal letters were written to a dozen firms describing minutely the character of the work and offering plans and specifications. Six replies were received and three bids tendered, two firms offering unit prices and cost-plus-per-cent. terms, while one submitted cost plus per cent. only.

It is said that one obstruction to letting work in this way is the fact that bonding companies, for various reasons, will not agree to qualify for this class of work.

Railroads Plan for Country's Largest Troop Movement

Plans for the largest troop movement in the history of the United States are being perfected by the American Railway Association at the request of the Government. Altogether 687,000 men, states Fairfax Harrison, president of the Railroads' War Board, will have to be transported to the various cantonments. The movement will start Sept. 5, and between then and Sept. 9, 200,000 men will be moved to their camps. The second movement of the same size will begin Sept. 19 and a third on Oct. 3. At the same time the railroads are asked to move 350,000 members of the National Guard to their training camps.

To give a conception of the magnitude of the undertaking, it is stated that to move one field army of 80,000 men requires 6229 cars, made up into 336 trains.

Lakewood City Engineer Quickly Reinstated in Office

"Not proven" was the prompt decision of the Civil Service Commission of Lakewood, Ohio, in the case of E. A. Fisher, city engineer, who was peremptorily removed from office by N. C. Cotafish, director of public works, a short time ago. In Director Cotafish's note discharging the city engineer no reason was given except absence from the city on a Saturday and Sunday without consulting the director, and "the good of the service." Subsequently the director filed "charges" as a ground for the removal. These all had to do with local routine matters. The Civil Service Commission heard testimony for a day from the director, the city engineer and a few others. It then declared all the charges unfounded or insufficient.

Government Will Create Bureau To Study Ceramics

The establishment of a mining experiment station at Columbus, Ohio, under the jurisdiction of the Bureau of Mines, the station to represent the ceramic industry of the United States, has been authorized by Franklin K. Lane, Secretary of the Interior. Located at Columbus, the center of the clay-working and allied industries, the bureau can work in coöperation with the School of Ceramics at Ohio State University.

Director Van H. Manning, of the Bureau of Mines, in recommending that the subject of ceramics be taken up at this station, said, in part: "No industry in this country offers more opportunity for constructive effort and new development than does the ceramic industry. Moreover, the clay-working and allied industries represent one-third of all capital invested in crude mineral industries and are, therefore, entitled to the same consideration as other industries now under study by the Government. . . . In the clay-working industries, as in many other mineral industries, the utilization of low-grade materials is now imperative in order to prevent exhaustion of those high-grade materials, which if exhausted would leave us at the mercy of foreign countries.

"In the ceramic industry the fuel consumed represents approximately 20% of the value of the wares produced, and as a rule a great deal of this fuel is unnecessarily wasted. Hence, the value of the fuel wasted is very large, and the lessening of this waste demands immediate study. Moreover, the manufacturing waste, due to faulty methods or practice, is very great, and at the present time there is no means of subsequently recovering this waste. It is believed that an enormous saving can be effected in the clay-working industry."

Government Will Require Warehouses

A great number of warehouses at various points will have to be built by the Government very soon, according to a recent report in the Official Bulletin. These are mainly to be at ocean terminals to take care of the congestion of supplies across the Atlantic, although some of them probably will be at inland centers where railway communication permits the assembly of goods for further transportation to the ocean terminals. This work is in charge of the Storage Committee of the General Munitions Board, of which M. L. Cooke is chairman.

This committe is endeavoring to introduce system into distribution methods in an effort to eliminate congestion, delay and double haulage, factors that seriously embarrass transportation systems in European countries engaged in the world war. Its aim is to simplify assemblage and storage of supplies required by the army or otherwise necessary to the prosecution of the war. In addition to the construction of warehouses, the committe will urge upon manufacturers the advisability of storage at the point of fabrication, where they will wait requisition for forwarding. It is proposed to establish points of local assembling at which goods in less than carload lots will be temporarily stored and full carloads made up for shipment.

Cleveland Still Wrestling with City Coal Problem

For the third time within a few months Cleveland, Ohio, has been unable to get satisfactory bids for 15,000 tons of coal for its garbage-reduction works. On the former occasions the bids were considered too high, but on the third call there were no bids at all. The purchase of a coal mine to supply all the needs of the city is under consideration. Prof. H. E. Nold, Ohio State University, is serving the city as coal expert.

Thames River Bridge Substructure Cost Over a Million

Construction of the piers and abutments for the new Thames River Bridge at New London, on the New York, New Haven & Hartford R.R., is completed, according to official announcement. The westerly three piers were sunk by open dredging, the depth of the two adjacent to the channel being 130 ft. below water. The east pier is a pneumatic caisson pier with three circular caissons. Holbrook, Cabot & Rollins Corporation, of Boston, carried out the work. The cost exceeds a million dollars.

The spans of the new bridge will be, from west to east, 185 ft., 330 ft., 212 ft., 330 ft. and 330 ft. The 212-ft. span contains a bascule draw. The superstructure is already contracted for. It will be built of silicon steel and will weigh about 5525 tons. Deliveries are practically impossible now, and work on the superstructure has not progressed.

The old Thames River Bridge, which is to be turned over to the State of Connecticut for highway use, contains a 503-ft. swing span; at the time of its construction in 1889 it was the longest swing-span in existence. The piers of the old bridge rest on wooden piles.

Montclair Paving Contract Readvertised

A quarter-million dollar contract for warrenite paving on Park St. and Bellevue Ave., Montclair, N. J., having been taken into the courts on a writ of certiorari by the lowest bidder, the Town Commission decided not to contest the case, the judge declared the award illegal and later the commission set Aug. 14 as the date for receiving new bids for warrenite alone, with the provision that the contractor receiving the award shall do the work. The original call for bids permitted tendering on other material than warrenite. The lowest bidder proposed the Topeka specifications.

Draftsmen and Clerks Wanted by Engineer Corps

Good Salaries as Well as Most Expenses Provided for Service in France

Service in Europe at good pay with the United States Engineer Corps is open to skilled clerks, stenographers, typewriters, bookkeepers and draftsmen. A notice sent out by the United States Department of Labor says:

"Wanted by the United States Engineer Corps for service in Europe, 150 clerks qualified as stenographers, typewriters, bookkeepers and general clerks, salary $1000 to $1200, in addition to which rations, quarters, medical and surgical treatment and transportation furnished. Also 50 draftsmen, topographical, architectural and mechanical, salary $1500 to $1800 per annum, dependent on experience and qualifications, in addition to quarters, rations and medical attention."

In three weeks the men selected will go into service. Applications should be addressed to the Chief of Engineers, U. S. A., Washington, or should be filed with P. A. Donohue, inspector in charge of the United States Employment Service, Room 8, United States Barge Office, New York. Men of conscript age are not desired.

Springfield Sells Garbage to Farmers for Hogs

Beginning Aug. 1, the City of Springfield, Mass., will collect all garbage and deliver it to farmers at two transfer stations. The farmers will feed it to hogs. The city will be paid $1 a ton or, where wagons are transferred between the city and the farmers, 2c. per cu.ft. For sometime the Merg Reduction Co. disposed of all garbage delivered to it by the city, without charge. The plant was declared to be a nuisance by the court and on June 30, 1916, it was closed. For a time the garbage was buried. Then farmers began to take some of it and feed it to hogs. Later the city began delivering it to the farmers at transfer stations. Under the new plan the city will resume the entire collection of garbage, granting no licenses for its transportation through the streets. F. H. Clark is superintendent of streets and engineering.

Donates Engineer to Red Cross

The engineering firm of Stone & Webster, of Boston, has donated the services of one of its engineers, Ernest McCullough, to the American Red Cross. Mr. McCullough was a major of engineers in the Officers' Reserve Corps, and upon his selection by his firm the Secretary of War assigned him to active duty in his rank and ordered him to report to the chairman of the Red Cross to accompany Maj. Grayson M. P. Murphy to France in connection with the work of the American Red Cross. Major McCullough is now in Paris.

PERSONAL NOTES

W. B. REED, formerly assistant city engineer of Roanoke, Va., has been appointed city manager of Portsmouth, Va., for a term of three years. His salary has been fixed at $4000, $4500 and $5000 for the first, second and third years respectively.

E. B. WALKER, JR., until recently with Reolds Farms Co., Lansing, Mich., in capacity of chief engineer on development of 27,000 acres of Florida land, including the City of Oldsmar, has accepted the position as engineer in charge of the Myrtle Hill Cemetery, Tampa, Florida.

F. C. HERRMANN consulting engineer, San Francisco, who is directing construction work now under way for the Modesto Irrigation District, has been appointed consulting engineer of the Turlock Irrigation District for the purpose of working out the drainage problems of that district. The two districts lie on adjacent areas in the San Joaquin Valley of California.

WILLIAM WATERS, of the firm of Baker, Carpenter & Waters, consulting engineers, San Francisco, has been appointed superintendent on the construction work at Camp Fremont, Menlo Park, California.

W. L. SHARP, civil engineer, Oregon City, Ore., who was a member of the engineering force which had charge of the Oregon City water system, under H. A. RANDS, has been appointed second lieutenant in the 18th Engineers Company, now in camp at American Lake, Washington.

F. R. TRUESDELL, who for the past three years has been employed in the valuation department of the Chicago & Northwestern Ry., has gone to the Michigan Central R.R. as assistant engineer, in the office of the division engineer at Jackson, Michigan.

E. M. KLING, consulting engineer for the Laconia Car Co., of Laconia, N. H., for the past 34 years, has tendered his resignation.

WILLIAM WREN HAY, junior engineer, United States Engineer Department, has been ordered for duty to France. For more than four years he was engaged in various works in Montreal and western Canada—particularly with the Canadian Pacific Ry. and the City of Calgary. For the past two years and a half he has been engaged in work for the Southern Department of the United States Army at Fort Sam Houston, Tex., and afterward at El Paso.

WILLIAM L. SACKETT has been appointed superintendent of waterways in the new State Department of Public Works and Buildings of Illinois. Mr. Sackett's headquarters will be at Springfield.

L. E. AYRES has accepted the position of principal assistant engineer with Gardner S. Williams, consulting engineer, Ann Arbor, Mich. Mr. Ayres has severed his connection with the consulting board for the Belle Isle bridge at Detroit.

R. K. HOLLAND and H. K. HOLLAND, who were formerly with Gardner S. Williams, consulting engineer, as principal assistant engineer and advising engineer respectively, have opened an office as consulting engineers at Ann Arbor, Michigan.

LEE H. POWELL, formerly chief engineer of Drainage District No. 1, Jacksonville, Tex., has been appointed city engineer of Tyler, Tex., being retained as consulting engineer on his previous work. B. RAINEY has been appointed to the place vacated by Mr. Powell.

S. L. CHURCH, supervisor of the Pennsylvania R.R. at Lancaster, Penn., has been appointed division engineer of the Delaware division, with headquarters at Wilmington, Delaware.

L. A. DOWNS, general superintendent of the Southern lines of the Illinois Central R.R., with headquarters at New Orleans, has been transferred to Chicago and will have charge of the Northern lines, embracing the Chicago terminal and the Illinois, Indiana and Springfield divisions. The Illinois Central has divided its lines north of the Ohio River into two grand divisions, the Western division comprising the Wisconsin, Minnesota and Iowa divisions.

S. H. LEA, formerly city engineer of Charlotte, N. C., is now associated with K. C. Gaynor, consulting engineer, Sioux City, Iowa.

CHESTER ALLISON has been engaged as engineer for the Calo-Verde Joint Levee District in California. Mr. Allison served for several years as chief engineer of the Imperial Irrigation District during the receivership of W. A. Holabird, having entered the employ of the district as a rodman and working up to the position of chief engineer. His first duty in the new position will be to start the work of preparing an estimate for a bond issue of approximately $650,000 to complete the levee system.

GEORGE H. WILLITS, who has been connected with the firm of Bartholow-Willits Engineering Co. for the past three years, has been appointed city engineer of Galveston, Tex., succeeding Albertus T. Vickey.

F. M. RINGELEY, who was graduated from the University of Texas in 1914, has been engaged as manager of the Bartholow-Willits Engineering Co., succeeding George H. Willits.

T. R. SWISS, city engineer of Vicksburg, Miss., has resigned to accept a commission in the Engineer Officers' Reserve Corps. At the time Mr. Swiss's resignation was accepted, a motion was made before the Board of Aldermen that he be reinstated in his present position upon his permanent return to civil life.

WALTER L. HENWOOD, [illegible] president of Lathrop, Shea & Henwood Co., Scranton, Penn., has received a commission as major, Engineer Officers' Reserve Corps, and is now engaged as constructing quartermaster of the cantonment at Camp Wheeler, Macon, Georgia.

ALEXANDER ROSS, civil engineer, of Seattle, Wash., died at his home in that city recently after an illness of over a year.

H. P. LETTON, sanitary engineer at the United States Marine Hospital, Chicago, has received a year's leave of absence to become chief of the Bureau of Sanitary Engineering of the Nebraska State Board of Health, at Lincoln, Nebraska.

KENNETH CASE, of the engineering force of the Alaskan Engineering Commission, has been made resident engineer in charge of Residency No. 4 on the Fairbanks Division. He relieves H. J. CHANDLER, who has been detailed to Lignite Creek, to locate a branch line to the coal fields.

A. O. JOHNSON, civil engineer, of Portland, Ore., died at Weed, Calif., July 14, at the age of 38. Since graduating from Stanford University in 1910 Mr. Johnson had been employed at Cordova, Alaska, and on the North Bank and Oregon electric lines in Oregon.

BUSINESS NEWS

Blaw Enters the Mixer Field

A. W. Ransome, who for nearly 20 years has been closely identified with the development and manufacture of concrete machinery, has joined the Blaw-Knox Co., of Pittsburgh. During the past two years Mr. Ransome has been developing and putting into practice sundry improved patents on concrete machinery, all of which have been purchased by the Blaw-Knox Co. and will be marketed and further developed under his direction as manager and chief engineer of the mixer department.

Business Men Call Big Patriotic War Convention

An emergency call has gone forth from the Chamber of Commerce of the United States to the business men of the country for a great war convention to be held at Atlantic City, Sept. 17-21. A principal topic of discussion will be the duty that business owes the Government in war. There will come the question of how the business of the country may render even greater service in winning the war. This will include what may be done to control prices, how priority may be most quickly and effectively established, how greater efficiency in land and water transportation shall be developed, how we may best provide for and protect our

forces on land and sea and those dependent upon them at home, and what steps may be taken for better education of the nation on the issues at stake.

Ways and means by which business must readily adjust itself to the conditions produced by the war will be considered. Also there will come the questions of how to provide for business enterprises not essential to the nation in wartime, food conservation, its special importance to business men, industrial relations and employment problems, and foreign trade, banking and credit in wartime.

Of particular interest will be the readjustment after the war for which business must prepare. This will include the question as to what will be the course of prices on raw materials and finished products after the war, how we shall plan for replacing our men in industry after they return from the war and what new responsibilities in international relations may be expected after the war.

Appointed on Fleet Corporation

W. J. Haynen, an experienced Southern lumberman, has been appointed to a position with the Emergency Fleet Corporation, while C. M. Morford has been appointed in the Bureau of Supplies and Accounts, which bureau is the purchasing office for the Navy Department.

Safety Congress and Exposition in New York Next Month

What is expected to be the largest safety and sanitation congress ever held has been called to take place in the Grand Central Palace, New York City, Sept. 10-15. Delegates from all over the world are to attend to discuss matters pertaining to the promotion and standardization of safety methods in factories, railroads and the various industries in which hazardous occupations are found.

Coincident with the congress there will be staged the largest Safety and Sanitation Exposition yet held, three large floors of the Grand Central Palace being used.

Great Increase inr Ion-Ore Production in 1916

The iron ore mined in the United States in 1916 reached a total of 75,-167,672 gross tons, the greatest annual output ever made. The shipments from the mines were 77,870,553 gross tons, valued at $181,902,277. The quantity mined in 1916 was more than 19,600,000 tons greater than that mined in 1915. The increases in quantity and in value in 1916 amounted to about 40 and 80% respectively. The average value per ton at the mines in 1916 was $2.34, as against $1.83 in 1915. These figures, which were compiled under the direction of E. F. Burchard, of the United States Geological Survey, Department of the Interior, include for 1916 only iron ore containing less than 5% of manganese.

The production of pig iron, including ferro-alloys, was 39,434,797 gross tons in 1916, compared with 29,916,213 gross tons in 1915, an increase of 32%, according to figures published by the American Iron and Steel Institute, Feb. 24, 1917. The pig iron, exclusive of ferro-alloys, sold or used in 1915, according to reports of producers to the United States Geological Survey, amounted to 39,126,324 gross tons, valued at $663,478,118, compared with 30,-384,486 gross tons, valued at $401,409,-604, in 1915, a gain of 29% in quantity and 65% in value. The average price per ton at furnaces in 1916 as reported to the survey was $16.96, compared with $13.21 in 1915, an increase of 28 per cent.

Board To Adjust Labor Disputes in Industrial Plants

The Council of National Defense has announced its decision to create a labor adjustment commission of nine members to have jurisdiction over all disputes concerning wages or conditions of employment in all establishments having contracts with the Government.

Contracts for 39 Wooden Hulls and 9 Steel Ships Let

Contracts were issued last week by the Emergency Fleet Corporation for the construction of 39 wooden hulls, six standard 8800-ton Robert Dollar type steel ships and three steel 6000-ton cargo-carrying steamers. For military reasons the names and locations of the contractors were withheld, but the contracts were distributed among 12 shipbuilders.

The total amount represented by the 48 contracts is $22,465,320. The cost of the wooden hulls was placed at $300,-000 each, the 8800-ton steamers at $1,364,000 each and the three cargo-carrying steamers at $908,440 each.

Form for War Contracts Is Recommended by Officials

The Department of Commerce authorizes the following:

As the result of conferences extending over two months, the interdepartmental cost conference has made public its recommendations that where fair prices can be obtained, war contracts should be in the form of straight purchase-and-sale contracts at fixed prices, that the cost-plus contract may be necessary where the production involves difficult and complicated manufacturing effort or conditions which cannot be clearly foreseen, and that in cost-plus contracts a fixed profit of a definite sum of money per article be agreed upon as far as possible, instead of the percentage of cost.

The conference was organized by Secretary Redfield and Burwell S. Cutler, acting chief of the Bureau of Foreign and Domestic Commerce, of the Department of Commerce, and representatives of the most interested Government bodies took part.

Notes from

MAKERS OF PLANT AND EQUIPMENT

The Garford Motor Truck Co., of Lima, Ohio, announces that its Houston, Tex., business will henceforth be in charge of the Houston Buick Sales Company.

The American Steel Export Co. has appointed Walter R. Morris assistant traffic manager, with headquarters in the Woolworth Building, New York.

C. E. Leslie has been appointed advertising manager of the Emerson-Brantingham Implement Co., Rockford, Ill. Mr. Leslie was formerly in the advertising department of Fairbanks, Morse & Company.

Y. L. Yepson, advertising manager of the National Fire Proofing Co., Pittsburgh, has been elected second vice president and manager of sales.

The Westinghouse Electric and Manufacturing Co. has promoted W. J. Longmore, formerly purchasing agent of the company at the East Pittsburgh works, to be general purchasing agent, with headquarters at Pittsburgh, Penn., where he will have supervision of the purchases of the company as a whole, with special supervision over those involving contracts for material used by both the electric and machine works. Charles G. Taylor, formerly assistant purchasing agent, has been promoted to the position of purchasing agent at East Pittsburgh, where he has headquarters, and also of the Shadyside, Cleveland and Newark works. A. W. Fullerton, formerly purchasing agent of the Westinghouse Machine Co., which is now known as the machine works of the Westinghouse Electric and Manufacturing Co., has been appointed purchasing agent of the machine works at East Pittsburgh, Trafford and Essington, with headquarters at the first-named place.

The Abell-Howe Co., Chicago, has been incorporated to provide for the expansion of the sales and engineering organization inaugurated some months ago by Oliver J. Abell, 565 Washington Boulevard, that city. Among the products to be sold exclusively through the Abell-Howe Co. are American high-speed chain and Howe one-man detachable tongue trucks. Oliver J. Abell is president and treasurer of the new company, Glenn G. Howe is vice president and C. E. Kane secretary.

The Standard Steel Castings Co., of Cleveland, Ohio, incorporated in 1912 for $125,000, has just increased its capital stock to $1,000,000. A new foundry and machine shop, now under construction, will be devoted exclusively to the manufacture and production of cast-steel truck wheels. This installation will cost approximately $350,000.

C. S. Vought, assistant general manager of sales of the American Steel Export Co., New York, sailed for France on Aug. 7, to attend to business for the company. Mr. Vought will be absent about 60 days.

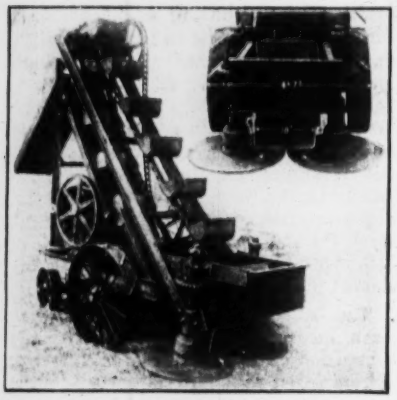
Warren Webster & Co. have appointed S. E. Vance as Washington district manager, with offices at 301 Southern Building.

Stanley W. Hull, 3729 Prospect Ave., Cleveland, has organized a new mechanical drafting service company for inventors and manufacturers, known as S. W. Hull & Co. For the past 10 years he has had experience in the engineering department of plants of the General Electric Co., Westinghouse Church Kerr & Co. and Brown Hoisting Machinery Company.

APPLIANCES AND MATERIALS

A Self-Feeding Wagon Loader

A new self-propelled power-driven elevator for loading sand, stone, gravel, coal, cinders, etc., from ground piles into wagons has been perfected by the Barber-Greene Co., of Aurora, Ill. The notable feature of the loader is an attachment for feeding the material into the elevator buckets, doing away with hand shoveling. There are two horizontal revolving disks close to the ground and these slide in under the pile



TWO DISKS FORCE MATERIAL FROM STOCKPILE TO ELEVATOR BUCKETS

and heap the material up where the buckets pick it up. Patents are pending.

These machines are furnished with gasoline-engine or electric-motor drive and are rated to handle 60 tons per hour.

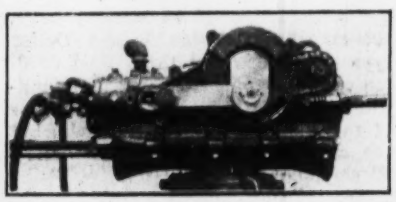
Recording Irrigation Meter Registers Acre-Feet

A recording irrigation meter, with a straight-reading dial showing total water passed in acre-feet, is offered by the Hydrometric Co., Central Building, Los Angeles, Calif. The meter may be used in a ditch or in a closed conduit. The water enters one side of a two-compartment meter box and passes out the other side with very slight loss of head. The entering side of the box converges to a throat and contains corrugated diaphragms leading to a vane hung in the throat. The diaphragms are designed to break up eddies. The vane is connected by means of a vertical brass rod to a gear train properly cased and provided with a straight-reading dial. There is a tool-steel ball bearing in a brass cup between the brass rod and the gear train. After the water passes the vane and throat, it goes upward through the other compartment of the meter box and on its way through the ditch or pipe, as the case may be. The meter stand is of cast iron. The meter box is of "Armco" iron. The device has been named "The Water Watch."

New Gasoline Rock Drill Appears

A new design of gasoline-driven rock drill developed by L. L. Scott, 1104 Bank of Commerce Building, St. Louis, Mo., is being put on the market by Mr. Scott.

The drill operates on the hammer principle. A hollow hexagon drill steel is used and the water for cooling the engine is run through the hollow steel



NEW GASOLINE DRILL HAS DOUBLE PISTON

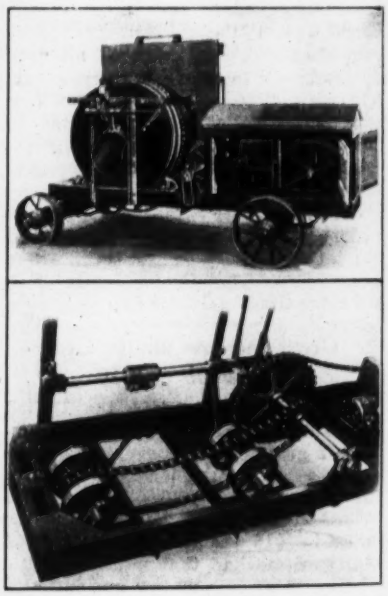
to the bottom of the drill hole. About 800 blows per minute are struck. The engine is a simple single-cylinder two-cycle unit and is free from valves, gears and cams. The hammer is moved directly by explosive pressure and strikes a free blow. There are two pistons, one contained within the other. The outside piston is the hammer and has no mechanical connection with the inside piston, which latter is connected to the crankshaft through connecting-rods. An explosion takes place with every down stroke, driving the two pistons downward. The hammer piston strikes its blow on a tappet at about 60° before the crankshaft has reached its lower dead center; the inside piston moves on (independent of the hammer piston) with the crankshaft. This inner piston uncovers air ports in the hammer piston and on the back stroke (caused by the momentum of the flywheels) the hammer is picked up on a cushion of air. Ball and roller bearings are used on the crankshaft and rotation shaft. The drill steel is rotated step by step by a special "compound" gear—no ratchets being used to get intermittent rotation. A standard double-thread worm is cut in half, and adjacent threads are connected by a straight no-pitch thread. The worm wheel is standard, with the exception that one side of each tooth is cut straight. The compound worm is driven by means of a chain and sprockets from the crankshaft. The worm wheel which is attached to the chuck rotates during one-half revolution of the worm and is stationary during one-half revolution. The rotation of the drill steel takes place only on the up stroke of the hammer.

One size of machine has been developed; this drills holes up to 12 ft. in depth, and weighs 200 lb. Gasoline is supplied from a small steel pressure tank—a pressure of 2 lb. is pumped up by hand twice per day. Electric ignition (Atwater-Kent) is used.

One of these drills operating at the Glencoe Lime and Cement Co., St. Louis, Mo., has drilled 68 ft. in a 9-hour day, using 2 gal. of gasoline and ¼ pint of cylinder oil. The rock was hard limestone.

New Idea in Chain-Driven Mixers

A radically new design of concrete-mixer drive has been evolved by the T. L. Smith Co., of Milwaukee, Wis. The drum is chain driven and carries a sprocket ring, but the chain does not go around the drum. Instead, it goes under the truck frame, as shown in the accompanying view, around an idler on the roller shaft and back under the drum sprocket. It is claimed that wear and stretch of the chain can never be enough so that there will be trouble, and that the lifting tendency of the



DESIGNED TO ELIMINATE STRETCH AND WEAR

chain reduces wear on rollers and roller bearings.

This machine (known as No. 7-S) has a 45 x 31-in. drum, a power loader of 10-cu.ft. capacity, an 18-gal. water tank, and is furnished with 5-hp. steam or gasoline engine. Without power equipment it weighs 3410 pounds.